PB82-101742

Pennsylvania Baseline

Ohio River Basin Energy Study
Urbana, IL

Prepared for

Environmental Protection Agency
Washington, DC

Apr 81

U.S. Department of Commerce
National Technical Information Service
NTIS

TECHNICAL REPORT DATA
(Please read Instructions on the reverse before completing)

1. REPORT NO. EPA-600/7-81-059	2. ORD Report	3. RECIPIENT'S ACCESSION NO. PB82 101742
4. TITLE AND SUBTITLE Pennsylvania Baseline		5. R April 1981
		6. PERFORMING ORGANIZATION CODE
7. AUTHOR(S) Maurice A. Shapiro, editor		8. PERFORMING ORGANIZATION REPORT NO.
9. PERFORMING ORGANIZATION NAME AND ADDRESS University of Pittsburgh Pittsburgh, Pennsylvania 15261		10. PROGRAM ELEMENT NO. C2JN1E
		11. CONTRACT/GRANT NO. R805608
12. SPONSORING AGENCY NAME AND ADDRESS U.S. Environmental Protection Agency Office of Research & Development Office of Environmental Engineering & Technology Washington, DC 20460		13. TYPE OF REPORT AND PERIOD COVERED
		14. SPONSORING AGENCY CODE EPA-ORD/17

15. SUPPLEMENTARY NOTES

This project is part of the EPA-planned and coordinated Federal Interagency Energy/Environment R&D Program.

16. ABSTRACT

This report was prepared as part of the Ohio River Basin Energy Study (ORBES), a multidisciplinary policy research program supported by the Environmental Protection Agency. Its purpose is to provide baseline information on Pennsylvania, one of the six states included partly or totally in the ORBES region. The topics covered are a historical synopsis of human activities in western Pennsylvania; geology, climatology, and soils; terrestrial ecology; surface hydrology; water quality; aquatic ecology; and socioeconomic characteristics.

17. KEY WORDS AND DOCUMENT ANALYSIS

a. DESCRIPTORS	b. IDENTIFIERS/OPEN ENDED TERMS	c. COSATI Field/Group
Ecology Environments Geography Hydrology, Limnology	Integrated Assessment	

18. DISTRIBUTION STATEMENT Release to public	19. SECURITY CLASS *(This Report)* unclassified	21. NO. OF PAGES 632
	20. SECURITY CLASS *(This page)* unclassified	22. PRICE

TYPING GUIDE SHEET
BEGIN FIRST LINE OF TEXT HERE
DROPPED HEAD, BEGIN SECTIONS HERE

EPA 600/7-81-059
April 1981
PB82-101742

PENNSYLVANIA BASELINE

Edited by

Maurice A. Shapiro
University of Pittsburgh
Pittsburgh, Pennsylvania 15261

Contributors

Richard A. Burgess
Norman K. Flint
George P. Kay
Maurice A. Shapiro
Rabinder K. Sharman
Attila A. Sooky
Jan L. Sykora

Prepared for

Ohio River Basin Energy Study (ORBES)

Grant No. EPA R805608

Project Officer

Lowell Smith
Office of Environmental Engineering and Technology
Office of Research and Development
U.S. Environmental Protection Agency
Washington, D.C. 20460

OFFICE OF RESEARCH AND DEVELOPMENT
U.S. ENVIRONMENTAL PROTECTION AGENCY
WASHINGTON, D.C. 20460

REPRODUCED BY
NATIONAL TECHNICAL
INFORMATION SERVICE
U.S. DEPARTMENT OF COMMERCE
SPRINGFIELD, VA 22161

BEGIN LAST LINE OF TEXT
BOTTOM OF IMAGE AREA OUTSIDE DIMENSION FOR TABLES AND ILLUSTRATIONS
EPA-287 (Cin.)
(4-76)

DISCLAIMER

This report has been reviewed by the Office of Research and Development, U.S. Environmental Protection Agency, and approved for publication. Approval does not signify that the contents necessarily reflect the views and policies of the U.S. Environmental Protection Agency, nor does mention of trade names or commercial products constitute endorsement or recommendation for use.

FOREWORD

The Ohio River Basin Energy Study (ORBES) is an interdisciplinary, multi-university inquiry into the environmental, economic, and social impacts of energy facility development in a major portion of the Ohio River Basin. The study was initiated by the U.S. Environmental Protection Agency in 1976 in response to a directive from the U.S. Senate Appropriations Committee.

Most of the ORBES research was conducted by a group of faculty members at the University of Illinois, Indiana University, the University of Kentucky, the University of Louisville, The Ohio State University, the University of Pittsburgh, Purdue University, and West Virginia University. In a few instances, the necessary expertise was found at other universities or independent research organizations.

This report is one of a series produced in support of the overall ORBES assessment. For a summary of the entire study, see Ohio River Basin Energy Study (ORBES): Main Report, by the ORBES Core Team, also being published by the U.S. Environmental Protection Agency.

CONTENTS

Part 1 - General Information

1.1 Nature of the ORBES Project 1

1.2 The Pennsylvania Baseline 1

1.3 A Historical Synopsis of Human Activities in Western Pennsylvania 7

- A. Introduction 7
- B. Lumber 9
- C. Transportation 10
- D. Oil 12
- E. Iron, Steel, and Coal 13

Part 2 - Impact Assessment Data Base

2.1 Characteristics and Human Utilization of Natural Ecosystems 17

2.1.1 Topography and Geology 17

2.1.1.1 Topographic Characteristics 17

- A. Introduction 17
- B. Pittsburgh Plateaus Section 17
- C. Glaciated Section 18
- D. Allegheny High Plateaus Section 19
- E. Allegheny Mountain Section 19

2.1.1.2 Geologic Characteristics 21

- A. Geologic Structure 21
- B. Stratigraphy 23
- C. Coal Resources 23
- D. Oil and Gas Resources 25
- E. Other Mineral Resources 26
- F. Seismicity 32

2.1.2 Climatology 34

2.1.2.1 Climatologic Characteristics 34

- A. General 34
- B. Precipitation 34
- C. Temperature 35
- D. Thunderstorms and Tornadoes 36

Preceding page blank

TYPING GUIDE SHEET

E. Flooding 36
F. Snow 37
G. Growing Season 37
H. Wind 37
I. Fog 38
J. Clear Days 38

2.1.2.2 Air Pollution Potential 38

A. Basic Meteorology 38
B. Teknekron Data 38

2.1.3 Soils 39

2.1.3.1 Soil Types and Distribution 39

A. General 39
B. Classification 39
C. Mapping 40

2.1.3.2 Soil Suitability for Waste Disposal 41

A. Methods 41
B. Site Suitability 42

References 96

2.1.4 Terrestrial Ecology 99

2.1.4.1 Vascular Flora 99

A. Prehistoric Forest Composition 99
B. Pre-Settlement Forest Composition 99
C. Past Impacts 100
D. Current Degree of Forestation 108
E. Modern Forest Composition 108
F. Herbaceous Flora of the Forest 114
G. The Field Community 114
H. Endangered Plant Species 114
I. Beneficial Aspects of Natural Vegetation 121

2.1.4.2 Vertebrate Fauna 130

A. Amphibians and Reptiles 130
B. Avifauna 135
C. Mammals 145

2.1.4.3 Specific Habitats 153

References 158

EPA-287 (Cin.)
(4-76)

TYPING GUIDE SHEET
BEGIN FIRST LINE OF TEXT HERE
CENTER OF PAGE
TOP OF IMAGE AREA
DROPPED HEAD: BEGIN SECTIONS HERE

2.1.5 Surface Hydrology 165

    2.1.5.1 Historical Considerations 165

        A. Prehistoric Surface Hydrology 165
        B. General Historical Characteristics 167
        C. Historical Description-Channels & Hydraulics 168
        D. Historical Flow Variation 170
        E. Human Modification of the River System 171

    2.1.5.2 The "Three Rivers" and Their Basins 174

        A. The Monongahela River Basin 174
        B. The Allegheny River Basin 183
        C. The Upper Ohio River Sub-Basin (PA) 192

    2.1.5.3 Stream Flow 196

        A. General Conditions 196
        B. Extreme Conditions 211

References 227

2.1.6 Water Quality 230

    2.1.6.1 Introduction 230

    2.1.6.2 Water Quality Data Sources 239

    2.1.6.3 Water Quality Control and Standards 253

        A. Federal Control 253
        B. State Control 254
        C. Water Quality Standards 263

    2.1.6.4 Surface Water Quality 284

        A. Monongahela River Basin 285
        B. Allegheny River Basin 320
        C. Ohio River Main Stem Basin 352

    2.1.6.5 Treatment and Discharge of Wastewaters 376

        A. Municipal Wastewaters 376
        B. Industrial Wastewaters 400

    2.1.6.6 Acid Mine Drainage and Control 423

        A. Introduction 423
        B. History of Acid Mine Drainage and Control 427
        C. Current Status (1970's) 445

BEGIN LAST LINE OF TEXT
BOTTOM OF IMAGE AREA OUTSIDE DIMENSION FOR TABLES AND ILLUSTRATIONS
3/8"
PAGE NUMBER
EPA-287 (Cin.)
(4-76)

References 465

2.1.7 Aquatic Ecology 470

    2.1.7.1 General Overview 470

        A. Historical Background 470
        B. Past Impacts 470
        C. Present Status 471

    2.1.7.2 The Monongahela River 472

        A. Phytoplankton 472
        B. Periphyton 473
        C. Zooplankton 473
        D. Aquatic Macrophytes 474
        E. Macrobenthos 474
        F. Fish 475
        G. Ecologically Important Basin Streams 476

    2.1.7.3 The Allegheny River 476

        A. Phytoplankton 476
        B. Periphyton 476
        C. Zooplankton 477
        D. Aquatic Macrophytes 477
        E. Macrobenthos 477
        F. Fish 477
        G. Ecologically Important Basin Streams 478

    2.1.7.4 The Upper Ohio River (PA) 478

        A. Phytoplankton 478
        B. Periphyton 478
        C. Zooplankton 479
        D. Aquatic Macrophytes 479
        E. Macrobenthos 479
        F. Fish 480
        G. Ecologically Important Sub-basin Streams 480

    2.1.7.5 Executive Summary 480

References 501

2.2 Socio-Economic Characteristics 504

    2.2.1 Demographic Composition 504

    2.2.2 Income 506

    2.2.3 Employment 508

2.2.4 Housing 510

2.2.5 Governmental Revenues and Expenditures 512

2.2.6 Public and Personal Services 515

2.2.7 Agriculture and Natural Resources 519

2.2.8 Summary of Socio-Economic Characteristics 522

Source Notes to Tables 528

Appendix A - Key to Alpha - Numeric Descriptors of Natural Areas in the Pennsylvania ORBES Region 579

Appendix B - Inventory of Western Pennsylvania Conservancy Natural Areas in the Pennsylvania ORBES Region 583

Appendix C - Habitat Preferences of the Fishes of Western Pennsylvania 599

TYPING GUIDE SHEET
BEGIN FIRST LINE OF TEXT HERE
CENTER OF PAGE
TOP OF IMAGE AREA
DROPPED HEAD: BEGIN SECTIONS HERE
9-1/8"
BEGIN LAST LINE OF TEXT
BOTTOM OF IMAGE AREA, OUTSIDE DIMENSION FOR TABLES AND ILLUSTRATIONS
3/8"
PAGE NUMBER
EPA-287 (Cin.)
(4-76)

TYPING GUIDE SHEET
BEGIN FIRST LINE OF TEXT HERE
CENTER OF PAGE
TOP OF IMAGE AREA
DROPPED HEAD: BEGIN SECTIONS HERE
BOTTOM OF IMAGE AREA OUTSIDE DIMENSION FOR TABLES AND ILLUSTRATIONS
BEGIN LAST LINE OF TEXT
PAGE NUMBER

FIGURES

Figure 1. Ohio River Basin Energy Study Phase II 2

Figure 2. Pennsylvania ORBES Counties 6

Figure 2.1.1-11 Annual Production of Crude Oil in Pennsylvania 51

Figure 2.1.1-1 Physiographic Provinces of Pennsylvania 63

Figure 2.1.1-2 ORBES Region Drainage 64

Figure 2.1.1-3 Geologic Map of Pennsylvania 65

Figure 2.1.1-4 Axial Trace of Anticlinal Structures in ORBES Region 66

Figure 2.1.1-5 Geologic Structure Section Through Beaver, Allegheny, Westmoreland, and Somerset Counties from Ohio River to Allegheny Front 67

Figure 2.1.1-6 Generalized Stratigraphic Section 68

Figure 2.1.1-7 Distribution of Pennsylvania Coals 69

Figure 2.1.1-8 Distribution of Pennsylvania Coals 70

Figure 2.1.1-9 Coal Seams of the Main Bituminous and Georges Creek Fields 71

Figure 2.1.1-10 Oil and Gas Fields Map of Pennsylvania 72

Figure 2.1.1-12 Production, Consumption, and Reserves of Natural Gas in Pennsylvania 73

Figure 2.1.1-13 Limestone and Dolomite Distribution in Pennsylvania . . 74

Figure 2.1.1-14 Water Yielding Capability of Rocks of Pennsylvania . . . 75

Figure 2.1.1-15 Tectonic Map 76

Figure 2.1.1-16 Earthquake Epicenters, 1800-1972 77

FIGURES (Continued)

Figure 2.1.1-17 New York - Alabama Lineament Plotted on Seismotectonic Map of Eastern United States (Hadley and Devine, 1974) Showing Earthquake Epicenters of Modified Mercalli III or Greater, Recorded from 1800 to 1972 78

Figure 2.1.1-18 Seismic Stations Operating During the Period July - September 1977 79

Figure 2.1.2-1 Mean Annual Precipitation, Inches 80

Figure 2.1.2-2 Mean Monthly Precipitation at Pittsburgh 81

Figure 2.1.2-3 Mean Annual Precipitation at Pittsburgh 81

Figure 2.1.2-4 Rainfall in Inches for 1-hour Duration and 2.33-Year Return Period 82

Figure 2.1.2-5 Rainfall in Inches for 24-hour Duration and 2.33-Year Return Period 83

Figure 2.1.2-6 Mean Minimum Temperature (°F), July 84

Figure 2.1.2-7 Mean Maximum Temperature (°F), July 85

Figure 2.1.2-8 Mean Minimum Temperature (°F), January 86

Figure 2.1.2-9 Mean Maximum Temperature (°F), January 87

Figure 2.1.2-10 Average Annual Snowfall 1962-1972 (in Inches) 88

Figure 2.1.2-11 Average Length of Growing Season (in Days) 88

Figure 2.1.2-12 Annual Snowfall at Pittsburgh 89

Figure 2.1.2-13 Mean Monthly Snowfall at Pittsburgh 1953-1976 89

Figure 2.1.2-14 Average Monthly Wind Speed at Pittsburgh 1968-1977 . . . 90

Figure 2.1.2-15 Maximum Monthly Wind Speed at Pittsburgh 1968-1977 . . . 90

Figure 2.1.2-16 Monthly Wind at Pittsburgh, 1968-1977: Resultant Wind, Average Speed, and Maximum Speed 90

Figure 2.1.2-17 Number of Clear Days at Pittsburgh 91

Figure 2.1.2-18 Number of Days of Thunderstorms and Heavy Fog at Pittsburgh 91

BEGIN FIRST LINE OF TEXT HERE
TYPING GUIDE SHEET
CENTER OF PAGE
TOP OF IMAGE AREA
DROPPED HEAD BEGIN SECTIONS HERE

FIGURES (Continued)

Figure 2.1.2-19 Monthly Temperature at Pittsburgh 91

Figure 2.1.2-20 Number of Times Destruction Was Caused by Tropical Storms, 1901-1955 92

Figure 2.1.2-21 Total Number of Forecast-Days of Meteorological Potential for Air Pollution Expected in a 5-year Period 92

Figure 2.1.3-1 General Soil Map 93

Figure 2.1.3-2 Standard Septic Tank-Seepage Bed System 95

Figure 2.1.4-1 Potential Natural Vegetation of Western Pennsylvania . . 101

Figure 2.1.4-2 Pennsylvania Lumber Production and National Rank 105

Figure 2.1.4-3 Historical Overview of Forestation in the Pennsylvania ORBES Region 110

Figure 2.1.4-4 Percent of County Land in the Forested Condition Pennsylvania ORBES Region - 1974 112

Figure 2.1.4-5 Major Forest Types of the Pennsylvania ORBES Region . . 118

Figure 2.1.4-6 County Level Herpetological Records for Rare Snakes in the Pennsylvania ORBES Region 134

Figure 2.1.4-7 Provisional Life-Zone Avifaunal Map of the Pennsylvania ORBES Region 137

Figure 2.1.4-8 State Game Lands of the Pennsylvania ORBES Region . . . 154

Figure 2.1.4-9 State and National Forests/Parks of the Pennsylvania ORBES Region 155

Figure 2.1.5-1 Present and Probable Preglacial Drainage Patterns of Western Pennsylvania 166

Figure 2.1.5-2 Map of Monongahela River Basin 175

Figure 2.1.5-3 Map of Allegheny River Basin 184

Figure 2.1.5-4 Pennsylvania Dept. of Environ. Resources Sub-basin #20 (Upper Ohio Main Stem) 193

Figure 2.1.5-5 Duration Curve of Flows for Sewickley, Pennsylvania . . 210

BEGIN LAST LINE OF TEXT
BOTTOM OF IMAGE AREA OUTSIDE DIMENSION FOR TABLES AND ILLUSTRATIONS
3/8"

PAGE NUMBER
EPA-287 (Cin.)
(4-76)

FIGURES (Continued)

Figure 2.1.5-6 Relation of Discharge at Cincinnati to Average Travel Rime of Water from Pittsburgh 212

Figure 2.1.5-7 Low Flow Variability in Western Pennsylvania 221

Figure 2.1.5-8 Minimum Seven Day Running Averages of Flow at Sewickley, PA 225

Figure 2.1.5-9 7 Day Running Average Flow at Sewickley, Pennsylvania . 226

Figure 2.1.6-1 Overlap of ORBES Region with COWAMP Study Areas and Counties 232

Figure 2.1.6-2 Overlap of ORBES Region with COWAMP Subbasins 234

Figure 2.1.6-3 Surface Water Quality Sampling Locations - Monongahela River Basin 248

Figure 2.1.6-4 Surface Water Quality Sampling Locations - Upper Allegheny River Basin 249

Figure 2.1.6-5 Surface Water Quality Sampling Locations - Middle Allegheny River Basin 250

Figure 2.1.6-6 Surface Water Quality Sampling Locations - Lower Allegheny River Basin 251

Figure 2.1.6-7 Surface Water Quality Sampling Locations - Ohio River Basin 252

Figure 2.1.6-8 Significant Interstate Waters of the Commonwealth of Pennsylvania 255

Figure 2.1.6-9 Pennsylvania Gazetteer of Streams - Index Map 258

Figure 2.1.6-10 Annual Water Quality - Monongahela River 290

Figure 2.1.6-10A Seasonal Variation of Water Quality: Monthly Averages - Monongahela River, 1970-1977 291

Figure 2.1.6-11 Monongahela River Surface Water Temperature 295

Figure 2.1.6-12 Monongahela River Surface Dissolved Oxygen Concentration 296

Figure 2.1.6-13 Monongahela River Surface pH 297

Figure 2.1.6-14 Monongahela River Conductivity (Midstream at Surface) . 298

TYPING GUIDE SHEET

FIGURES (Continued)

Figure 2.1.6-15 Monongahela River Sulfates (Midstream at One Meter Depth) 299

Figure 2.1.6-16 Monongahela River Nonfiltrable Solids (Midstream at One Meter Depth) 300

Figure 2.1.6-17 Monongahela River Transparency (Midstream) 301

Figure 2.1.6-18 Monongahela River NO_2+NO_3 (Midstream at One Meter Depth) 302

Figure 2.1.6-19 Monongahela River Total Iron (Midstream at One Meter Depth) 303

Figure 2.1.6-20 Youghiogheny River Water Temperature 1975 305

Figure 2.1.6-21 Maximum, Minimum, and Mean Monthly pH of the Youghiogheny River at Connellsville, PA 306

Figure 2.1.6-22 Spatial Water Quality Profile - Casselman River, April 1974 307

Figure 2.1.6-23 Spatial Water Quality Profile - Laurel Hill Creek, April 1974 308

Figure 2.1.6-24 Annual Water Quality - Allegheny River at Oakmont . . . 322

Figure 2.1.6-25 Seasonal Variation of Water Quality: Monthly Averages - Allegheny River at Oakmont, 1970-1977 323

Figure 2.1.6-26 Spatial Water Quality Profile - Little Conemaugh/ Conemaugh River, October 1974 331

Figure 2.1.6-27 Spatial Water Quality Profile - Stony Creek, March 1973 332

Figure 2.1.6-28 Temporal Water Quality Profile - Conemaugh River, Station 811, 1970-1974 333

Figure 2.1.6-29 Annual Water Quality - Ohio River at South Heights . . . 357

Figure 2.1.6-30 Seasonal Variation of Water Quality: Monthly Averages - Ohio River at South Heights, 1970-1977 . . . 358

Figure 2.1.6-31 Annual Water Quality - Beaver River at Beaver Falls . . 359

Figure 2.1.6-32 Seasonal Variation of Water Quality: Monthly Averages - Beaver River at Beaver Falls, 1970-1977 . . . 360

EPA-287 (Cin.)
(4-76)

TYPING GUIDE SHEET

FIGURES (Continued)

Figure 2.1.6-33 Comparison of Cumulative Coal Production and Fluctuation in Monongahela River Acid Levels: 1917-1940 428

Figure 2.1.6-34 Acidity Levels in the Monongahela River: 1931-1947 . . 429

Figure 2.1.6-35 Comparison of Mine Acid Loads by State in the Ohio River Basin in 1940 435

Figure 2.1.6-36 1963 Acidity and Alkalinity in the Monongahela River - 1940 Acidity Comparison 438

Figure 2.1.6-37 1963 Acidity and Alkalinity in the Youghiogheny River - 1940 Acidity Comparison 439

Figure 2.1.6-38 Tributaries of the Allegheny River Affected by Coal Mine Wastes in the Late 1960's 442

Figure 2.1.6-39 Tributaries of the Monongahela River Affected by Coal Mine Wastes in the Late 1960's 443

Figure 2.1.6-40 Map of the Monongahela River Basin 444

Figure 2.1.6-41 Variation in pH Along the Monongahela River in 1973 . . 450

Figure 2.1.7-1 Monongahela River Total Phytoplankton 494

Figure 2.1.7-2 Composition of Monongahela River Phytoplankton Community - July 1975 495

Figure 2.1.7-3 Numbers and Composition of Attached Growths, Upper Ohio River System, May-June 1970 496

Figure 2.1.7-4 Number of Periphyton Genera in the Attached Growth Communities of the Upper Ohio River System, May-June 1970 497

Figure 2.1.7-5 Quantity of Chlorophyll in the Attached Growth Communities of the Upper Ohio River System, May-June 1970 498

Figure 2.1.7-6 Benthic Fauna Collected in Rock Basket Samplers, Upper Ohio River Basin, May-June 1970 499

Figure 2.1.7-7 Relative Diversity of Aquatic Fauna in the Pennsylvania ORBES Counties 500

EPA-287 (Cin.)
(4-76)

FIGURES (Continued)

Figure 2.2.1-1A Pennsylvania ORBES Counties: Percent Population Change 1960-1970 530

Figure 2.2.1-1B Pennsylvania ORBES Counties: Percent Population Change 1970-1975 531

Figure 2.2.7-1 Industrial Minerals Produced in Pennsylvania, Mining Fuels Not Included 565

Figure 2.2.8-1 Labor Market Areas of Pennsylvania 566

Figure 2.2.8-2 Pennsylvania ORBES Counties: County Groupings Based on Ranking in Ten Socio-Economic Measures 567

TYPING GUIDE SHEET
EPA-237 (Cin.)
(4-76)

TABLES

Table 1. Topical Areas of Baseline for the Pennsylvania ORBES Region 4

Table 2. University of Pittsburgh Research Team Ohio River Basin Energy Study's Pennsylvania Baseline 5

Table 2.1.1-1 Recoverable Coal Reserves of Pennsylvania Over 24, 28, and 36 Inches Thick by Counties and Rank as of January 1, 1970 (Millions of short tons) 44

Table 2.1.1-2 In-place Coal Reserves of Pennsylvania by Counties as of January 1, 1970 (Millions of short tons) 45

Table 2.1.1-3 In-place Reserves of the Pittsburgh Coal as of January 1, 1970 (Millions of tons) 45

Table 2.1.1-4 Estimated Strippable Coal Reserves of 16 Southwestern Pennsylvania Counties, January 1, 1968, by Seams (Thousands of short tons) 46

Table 2.1.1-5 Estimated Strippable Coal Reserves of 16 Southwestern Pennsylvania Counties, January 1, 1968, by Counties and Seams (Thousands of short tons). 47

Table 2.1.1-6 Estimated Strippable Coal Reserves of 16 Southwestern Pennsylvania Counties, January 1, 1968, by Seam and Sulfur Content (Thousands of short tons) 50

Table 2.1.1-7 Production and Reserves of Oil and Gas in Pennsylvania . 51

Table 2.1.2-1 Monthly Mean Precipitation at 30 Weather Stations in ORBES Region 52

Table 2.1.2-2 Monthly Mean Precipitation at 7 Weather Stations in ORBES Region 53

Table 2.1.2-3 Maximum Amount of Precipitation at Various Intervals . . 54

Table 2.1.3-1 Soil Properties and Limitations Affecting Selected Land Uses 55

Table 2.1.3-2 Industrial Waste Disposal Sites in the Pennsylvania ORBES Region 57

TABLES (Continued)

Table 2.1.3-3 Summarized Criteria and Standards for Land Disposal of Wastes 61

Table 2.1.3-4 Area Covered by Soils Suitable for Land Disposal of Wastes 62

Table 2.1.4-1 Potential Natural Vegetation of the ORBES-Pennsylvania Study Region (Kuchler Types) 102

Table 2.1.4-2 List of Commercial Tree Species Found on Forest Survey Sample Plots in the State of Pennsylvania 106

Table 2.1.4-3 1964 Harvest Rankings for ORBES Counties Among the Top Ten Counties in the State 109

Table 2.1.4-4 Historical Trends in County-Specific Forestation 111

Table 2.1.4-5 Ownership of Commercial Forest Lands in ORBES-Pennsylvania 115

Table 2.1.4-6 Definitions of Forest Cover Types Appearing in Table 2.1.4-7 116

Table 2.1.4-7 ORBES - Pennsylvania Commercial Forest Composition by Tree Association 117

Table 2.1.4-8 Endangered and Threatened Plant Species in the State of Pennsylvania 119

Table 2.1.4-9 Rare Plants of the Pennsylvania 19-County ORBES Region . 122

Table 2.1.4-10 Rare Plants of Counties Near the Pennsylvania ORBES-Region 124

Table 2.1.4-11 Representative Erosion Rates for Various Land Uses . . . 128

Table 2.1.4-12 1974 Land Use and Calculated Erosion Rates in Western Pennsylvania 129

Table 2.1.4-13 Pennsylvania Fish Commission List of Endangered, Threatened, or Status Indeterminate Amphibians and Reptiles 132

Table 2.1.4-14 Key to Legend of Provisional Life-Zone Avifauna Map . . . 138

Table 2.1.4-15 Ring-Necked Pheasant Population Data for Pennsylvania ORBES Counties 141

TABLES (Continued)

Table 2.1.4-16 Ruffed Grouse Population Data for Pennsylvania ORBES Counties 142

Table 2.1.4-17 Wild Turkey Population Data for Some Pennsylvania ORBES Counties 143

Table 2.1.4-18 Gray Squirrel Population Data for Pennsylvania ORBES Counties 147

Table 2.1.4-19 Cottontail Rabbit Population Data for Pennsylvania ORBES Counties 148

Table 2.1.4-20 White-Tailed Deer Population Data for Pennsylvania ORBES Counties 149

Table 2.1.4-21 Average Annual Reported White-Tailed Deer Mortalities Due to Traffic Mishaps in the Pennsylvania ORBES Counties 151

Table 2.1.4-22 State and National Park Land of the Pennsylvania ORBES Region 157

Table 2.1.5-1 Counties of the Monongahela River Basin 177

Table 2.1.5-2 Physiographic Characteristics of Major Streams of the Monongahela River Basin 178

Table 2.1.5-3 Characteristics of the Monongahela River Navigation System 180

Table 2.1.5-4 Major Multipurpose and Power Generation Reservoirs in the Monongahela River Basin 182

Table 2.1.5-5 Counties of the Allegheny River Basin 186

Table 2.1.5-6 Physiographic Characteristics of Major Streams of the Allegheny River Basin 187

Table 2.1.5-7 Characteristics of the Allegheny River Navigation System 189

Table 2.1.5-8 Major Flood Control and Multi-Purpose Reservoirs in the Allegheny River Basin 191

Table 2.1.5-9 Counties of PA DER Sub-basin #20 (Upper Ohio - Beaver Basins within Pennsylvania) 194

Table 2.1.5-10 Characteristics of the Upper Ohio River Navigation System 197

TYPING GUIDE SHEET

TABLES (Continued)

Table 2.1.5-11 Major Reservoirs of the Beaver River Basin 198

Table 2.1.5-12 Hydrologic Characteristics of Monongahela Basin Streams 200

Table 2.1.5-13 Flow Duration Characteristics of Streams in the Monongahela River Basin 201

Table 2.1.5-14 Hydrologic Characteristics of Allegheny River Basin Streams 204

Table 2.1.5-15 Flow Duration Characteristics of Streams in the Allegheny River Basin 205

Table 2.1.5-16 Flow Duration Characteristics of the Allegheny River at Natrona, Pennsylvania 206

Table 2.1.5-17 Hydrologic Characteristics of Ohio River Main Stem and Tributaries 208

Table 2.1.5-18 Flow Duration and Characteristics of Streams in the Upper Ohio River Basin (PA) 209

Table 2.1.5-19 Great Floods on Major Rivers of Western Pennsylvania . . 213

Table 2.1.5-20 Allegheny River Discharges for Various Floods 215

Table 2.1.5-21 Monongahela River Discharges for Various Floods 216

Table 2.1.5-22 Flood Flows and Elevations - Allegheny River 217

Table 2.1.5-23 Flood Flows and Elevations - Monongahela River 218

Table 2.1.5-24 7-Day, 10-Year Low Flows in the Monongahela River Basin . 222

Table 2.1.5-25 7-Day, 10-Year Low Flows in the Allegheny River Basin . . 223

Table 2.1.5-26 7-Day, 10-Year Low Flows in the Upper Ohio and Beaver Basins 224

Table 2.1.6-1 ORBES Counties in COWAMP Study Areas 231

Table 2.1.6-2 List of Pertinent Plates in COWAMP Reports 235

Table 2.1.6-3 Surface Water Quality Sampling Locations 243

Table 2.1.6-4 Major Drainage Areas and Tributaries in the PA ORBES Region 259

EPA-287 (Cin.)
(4-76)

TABLES (Continued)

Table 2.1.6-5 Conservation Area Watersheds in ORBES Counties in Pennsylvania 260

Table 2.1.6-6 Proposed Pennsylvania Scenic Rivers in the ORBES Region 264

Table 2.1.6-7 Proposed Water Quality Standards as of March 1978: Definitions 271

Table 2.1.6-8 Proposed Water Quality Standards as of March 1978: Protected Water Uses 272

Table 2.1.6-9 Proposed Water Quality Standards as of March 1978: Water Quality Criteria Applications 273

Table 2.1.6-10 Proposed Water Quality Standards as of March 1978: Specific Water Quality Criteria 275

Table 2.1.6-11 Proposed Water Quality Standards (as of March 1978) for Major Streams in the PA ORBES Region 278

Table 2.1.6-12 Mean Values of Selected Parameters at Sampling Stations in the Monongahela River Basin (Data Collected from June 1962 to December 1974) 292

Table 2.1.6-13 Monongahela River Water Quality (From EPA STORET System) 293

Table 2.1.6-13A Monongahela and Youghiogheny River Water Quality, 1975-77 294

Table 2.1.6-14 Classification and Quality Problems of Major Streams - Monongahela River Basin 309

Table 2.1.6-15 Compliance Status 1975 - Monongahela River Basin 313

Table 2.1.6-16 Streams Showing Water Quality Improvements (1973-1977) - Monongahela River Basin 318

Table 2.1.6-17 Streams Showing Water Quality Degradation (1973-1977) - Monongahela River Basin 319

Table 2.1.6-18 Mean Values of Selected Parameters at Sampling Stations in the Upper Allegheny River Basin (Data Collected from May 1962 to December 1974) 325

Table 2.1.6-19 Mean Values of Selected Parameters at Sampling Stations in the Middle and Lower Allegheny River Basins (Data Collected from June 1963 to December 1974) 326

TYPING GUIDE SHEET
BEGIN FIRST LINE OF TEXT HERE
CENTER OF PAGE
TOP OF IMAGE AREA
DROPPED HEAD: BEGIN SECTIONS HERE

TABLES (Continued)

Table 2.1.6-20 Allegheny River Water Quality (from EPA STORET System) 327

Table 2.1.6-21 Allegheny River Water Quality, 1975-1977 329

Table 2.1.6-22 Kiskiminetas, Conemaugh, and Clarion River Water Quality, 1975-1977 (from EPA STORET System) 330

Table 2.1.6-23 Classification and Quality Problems of Major Streams - Allegheny River Basin 334

Table 2.1.6-24 Compliance Status 1975 - Allegheny River Basin 341

Table 2.1.6-25 Streams Showing Water Quality Improvements (1973-1977) - Allegheny River Basin 348

Table 2.1.6-26 Streams Showing Water Quality Degradation (1973-1977) - Allegheny River Basin 351

Table 2.1.6-27 Contributions to the Ohio River by the Allegheny and Monongahela Rivers 353

Table 2.1.6-28 Changes in Mean Stream Loads in the Pittsburgh, PA Study Area (Tons/Day, Except Phenols) 355

Table 2.1.6-29 Mean Values of Selected Parameters at Sampling Stations in the Ohio River Main Stem Basin (Data Collected from June 1962 to December 1974) 362

Table 2.1.6-30 Ohio and Beaver River Water Quality, 1975-1977 363

Table 2.1.6-31 Ohio and Beaver River Water Quality, 1977 364

Table 2.1.6-32 Classification and Quality Problems of Major Streams - Ohio River Main Stem Basin 365

Table 2.1.6-33 Compliance Status 1975 - Ohio River Main Stem Basin . . 368

Table 2.1.6-34 Streams Showing Water Quality Improvements (1973-1977) - Ohio River Basin 373

Table 2.1.6-35 Streams Showing Water Quality Degradation (1973-1977) - Ohio River Basin 375

Table 2.1.6-36 Existing Waste Water Treatment Requirements 377

Table 2.1.6-37 Proposed Revisions to Waste Water Treatment Requirements as of March 1978 380

BEGIN LAST LINE OF TEXT
BOTTOM OF IMAGE AREA OUTSIDE DIMENSION FOR TABLES AND ILLUSTRATIONS
PAGE NUMBER
EPA-287 (Cin.)
(4-76)

BEGIN FIRST LINE OF TEXT HERE
TYPING GUIDE SHEET
CENTER OF PAGE
TOP OF IMAGE AREA
DROPPED HEAD; BEGIN SECTIONS HERE

TABLES (Continued)

Table 2.1.6-38 Treatment Levels and Their Corresponding Expected Effluent Concentrations 382
Table 2.1.6-39 Municipal Facilities Summary: COWAMP Areas #8 & #9 . . 384
Table 2.1.6-40 Non-Municipal Facilities Summary: COWAMP Areas #8 & #9 386
Table 2.1.6-41 Important Municipal Facilities by Flow: COWAMP Area #9 389
Table 2.1.6-42 Waste Flow and Stream Flow for Major Urban Areas: COWAMP Areas #8 & #9 390
Table 2.1.6-43 Municipal Waste Discharges to Small Streams: COWAMP Areas #8 & #9 394
Table 2.1.6-44 Existing Industrial Waste Treatment Requirements 401
Table 2.1.6-45 Proposed Revisions to Industrial Waste Treatment Requirements as of March 1978 410
Table 2.1.6-46 Areas with High Concentrations of Industrial Discharges: COWAMP Area #9 411
Table 2.1.6-47 Industrial Direct Stream Discharge Summary by Major SIC Groups - COWAMP Area #9 415
Table 2.1.6-48 Industrial Direct Stream Discharge Summary by Major SIC Groups - COWAMP Area #8 416
Table 2.1.6-49 1940 Acid Loads in the Upper Ohio Basin Compared to the Ohio River Mainstem 431
Table 2.1.6-50 Abandoned Mine Acid Load and Removal (in 1940) Due to Sealing Programs in the Upper Ohio River Basin . . . 431
Table 2.1.6-51 1940 Cost of Damage Due to Acid Mine Drainage in the Upper Ohio River Basin 433
Table 2.1.6-52 Comparison of pH Values in the Upper Ohio River Basin Between 1940 and 1965 441
Table 2.1.6-53 Recent Water Quality Violations at Acid Mine Drainage Treatment Plants in Western Pennsylvania 447
Table 2.1.6-54 Deep Mine Drainage Treatment Summary in the PA ORBES Region as of 1975 457

6-1/2"
9-1/2"
BEGIN LAST LINE OF TEXT
BOTTOM OF IMAGE AREA OUTSIDE DIMENSION FOR TABLES AND ILLUSTRATIONS
3/8"

PAGE NUMBER
EPA-287 (Cin.)
(4-76)

TABLES (Continued)

Table 2.1.6-55 Surface Mine Drainage Treatment Summary in the PA ORBES Region as of 1975 458

Table 2.1.6-56 Acidity and Iron Loads in the Streams of Western Pennsylvania 460

Table 2.1.6-57 Number of Operation SCARLIFT Projects in Western Pennsylvania Counties (As of December 1975) 463

Table 2.1.6-58 Acid Mine Drainage Sludge Production Summary 464

Table 2.1.7-1 Impacted Fish Species of the Upper Ohio River Basin . . . 482

Table 2.1.7-2 Pennsylvania Fish Commission List of Endangered, Threatened, or Status Indeterminate Fishes 483

Table 2.1.7-3 Major Phytoplankton Genera of the Monongahela, Lower Allegheny, and Upper Ohio Rivers 484

Table 2.1.7-4 Zooplankton Taxa of the Monongahela River - April 1975 486

Table 2.1.7-5 Aquatic Macrophytes of the Monongahela River - Summer 1975 487

Table 2.1.7-6 Density of Benthic Macroinvertebrates Collected at Monongahela River Stations During April 1975 488

Table 2.1.7-7 Summary of Fish Sampling Data from the Monongahela River 1967-1973 489

Table 2.1.7-8 Fishery Survey Results for Reaches of the Monongahela and Ohio Rivers in Pennsylvania 490

Table 2.1.7-9 Aquatic Macrophytes of the Allegheny River - 1977 492

Table 2.1.7-10 Species of Fish Collected from Pools 3, 5, and 7 of the Allegheny River, 1975-1977 493

Table 2.2.1-1 Population Trends 1960 to 1975 for Pennsylvania ORBES Counties and State ORBES Totals 532

Table 2.2.1-2 Population Characteristics, Pennsylvania ORBES Counties . 533

Table 2.2.1-3a Age Distribution as a Percent of County Population, 1970 Census 534

Table 2.1.3-3b Dependency Ratios and Population for Pennsylvania ORBES Counties, 1950, 1960, and 1970 535

TYPING GUIDE SHEET

TABLES (Continued)

Table 2.2.2-1 Income Trends for Pennsylvania ORBES Counties 536

Table 2.2.2-2 Family Income 1970 Income Range, Percent of Families . . . 537

Table 2.2.3-1 Trends in Labor Force, Pennsylvania ORBES Counties 538

Table 2.2.3-2 Employment Covered by the Unemployment Compensation Law by Industry Group, Pennsylvania ORBES Counties, First Quarter, 1972, 1975 539

Table 2.2.3-3 Employment Characteristics, Pennsylvania ORBES Counties, Durable Goods Employment, Number Employed In 540

Table 2.2.3-4 Employment Characteristics, Pennsylvania ORBES Counties, Number of Craftsmen, Foremen, and Kindred Workers 541

Table 2.2.3-5 Employment Characteristics, Pennsylvania ORBES Counties, Management, Administration, and Sales, Number Employed In 542

Table 2.2.3-6 Employment Characteristics, Pennsylvania ORBES Counties, Services Employment, Number Employed In 543

Table 2.2.3-7 Employment Characteristics, Pennsylvania ORBES Counties, Trade and Finance Employment, Number Employed In 544

Table 2.2.3-8 Employment Characteristics, Pennsylvania ORBES Counties, Professional, Technical, and Kindred Employment, Number Employed In 545

Table 2.2.3-9 Employment Characteristics, Non-Durable Goods Employment, Number Employed In 546

Table 2.2.4-1 Housing Characteristics, Pennsylvania ORBES Counties . . . 547

Table 2.2.4-2 Housing Characteristics, Pennsylvania ORBES Counties . . . 548

Table 2.2.4-3 Housing Characteristics, Pennsylvania ORBES Counties . . . 549

Table 2.2.4-4 Housing Characteristics, Pennsylvania ORBES Counties . . . 550

Table 2.2.4-5 Housing Characteristics, Pennsylvania ORBES Counties, Housing Units, Rental Costs 551

Table 2.2.5-1 Government Revenues and Expenditures, Pennsylvania ORBES Counties - 1974 552

Table 2.2.5-2 Act 511 Taxes Collected by Municipalities, $X1,000-1974 . 553

EPA-287 (Cin.)
(4-76)

TABLES (Continued)

Table 2.2.5-3 Taxable Real Property Market and Assessed Values 1970-1975, Pennsylvania ORBES Counties 554

Table 2.2.6-1 Education-General Fund Revenue and Expenditures 555

Table 2.2.6-2 School Taxes Collected and General Fund Revenue 556

Table 2.2.6-3 Public Assistance Expenditures (Thousands of Dollars) . . 557

Table 2.2.6-4 Expenditures for Medical Care by Program Class (Thousands of Dollars) 558

Table 2.2.6-5 Health Care Statistics, Pennsylvania ORBES Counties . . . 559

Table 2.2.6-6 Characteristics of Water Utilities and Sewer Authorities 560

Table 2.2.7-1 Agricultural Cash Receipts-1974 % of 1971 Receipts, Pennsylvania ORBES Counties, Crops 561

Table 2.2.7-2 Land Use, Inventories - Acres X 1000, 1968 and 1974 . . . 563

Table 2.2.7-3 Crude Petroleum Shipments as % of 1970 Shipments 564

Table 2.2.8-1 Pennsylvania ORBES Counties Aged Dependency Ratio as Percent of Total Dependency Ratio, 1970 568

Table 2.2.8-2 Pennsylvania ORBES Counties Population Density - Persons per Square Mile, 1970 569

Table 2.2.8-3 Pennsylvania ORBES Counties Median Family Income, 1970 . 570

Table 2.2.8-4 Pennsylvania ORBES Counties Percent Change in the Labor Force, 1960-1970 571

Table 2.2.8-5 Pennsylvania ORBES Counties Percent Change in Manufacturing Employment, 1972-1975 572

Table 2.2.8-6 Pennsylvania ORBES Counties Percent of Housing Constructed, 1960-1970 573

Table 2.2.8-7 Pennsylvania ORBES Counties Percent Change in Taxable Real Property Market Value, 1970-1975 574

Table 2.2.8-8 Pennsylvania ORBES Counties Percent of Population Receiving Public Assistance, 1976 575

Table 2.2.9-9 Pennsylvania ORBES Counties 1975 Per Pupil Education Expenditure 576

TYPING GUIDE SHEET
BEGIN FIRST LINE OF TEXT HERE
CENTER OF PAGE
TOP OF IMAGE AREA
DROPPED HEAD BEGIN SECTIONS HERE
6-1/2"
9-1/8"
BEGIN LAST LINE OF TEXT
BOTTOM OF IMAGE AREA OUTSIDE DIMENSION FOR TABLES AND ILLUSTRATIONS
3/8"
PAGE NUMBER
EPA-287 (Cin.)
(4-76)

TABLES (Continued)

Table 2.2.8-10 Pennsylvania ORBES Counties Percent of State Contribution to 1975 Per Pupil Education Expenditure . . 577

Table 2.2.8-11 Pennsylvania ORBES Counties Ranking of County Values for Ten Characteristics 578

EPA-287 (Cin.)
(4-76)

Part 1 - GENERAL INFORMATION

1.1 NATURE OF THE ORBES PROJECT

The Ohio River Basin Energy Study (ORBES) is an integrated technology assessment funded by the U.S. Environmental Protection Agency. This interdisciplinary endeavor is currently in its third year of research (Phase II). The objective of the project is to ascertain plausible environmental, economic, and sociological impacts of energy development in the Ohio River Basin under six hypothetical energy scenarios (futures). The ORBES study region includes part or all of the six states bordering the river: substantial portions of Illinois, Indiana, and Ohio (excluding the northern tier counties), all of Kentucky, southwestern Pennsylvania, and most of West Virginia (Figure 1). Academicians from the University of Illinois, University of Kentucky, University of Louisville, Indiana University, Ohio State University, Purdue University, West Virginia University, and the University of Pittsburgh provide technical expertise in the fields of ecology, economics, engineering, geography, health, law, sociology, planning, and political science.

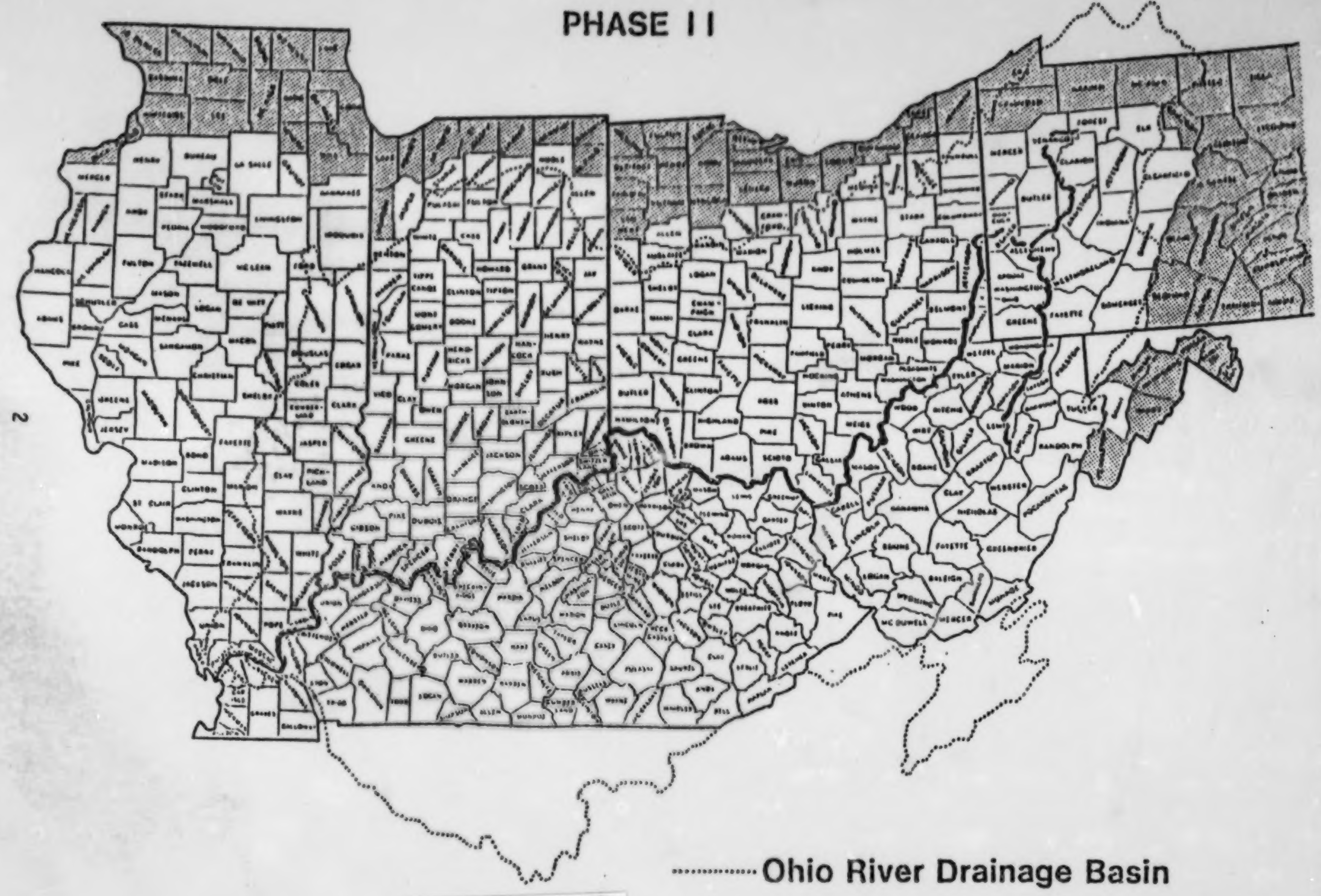
1.2 THE PENNSYLVANIA BASELINE

Early in the project, environmental/socio-economic "baselines" of each state were deemed to be requisite input in order to establish a solid foundation from which to conduct energy impact analyses. A baseline consists of a series of in-depth documents which describe the existing resources and environmental status of a state's ORBES region and at the same time provide a historical overview of changes in these resources. The resulting characterization provides a perspective -- it presents the

FIGURE 1

OHIO RIVER BASIN ENERGY STUDY REGION

PHASE II


Ohio River Drainage Basin

Reproduced from best available copy.

data necessary to gauge the magnitude and significance of future impacts. The Pennsylvania baseline is comprised of six documents (Table 1) which contain the most current and pertinent information available for eight topical areas generally addressed in environmental impacts statements: geology, climatology, soils, terrestrial ecology, hydrology, water quality, aquatic ecology, and socio-economics. Data analysis and interpretation by the seven contributing authors (Table 2) makes these documents a valuable source of information for both the ORBES Project and agencies concerned with the management of Western Pennsylvania's resources.

The Pennsylvania ORBES region encompasses 13,800 square miles of Western Pennsylvania. The region contains all of the following nineteen counties: Allegheny, Armstrong, Beaver, Butler, Cambria, Clearfield, Clarion, Elk, Fayette, Forest, Greene, Indiana, Jefferson, Lawrence, Mercer, Somerset, Venango, Washington, and Westmoreland. Figure 2 illustrates the location of these counties in Western Pennsylvania. The county abbreviations employed in Figure 2 are also utilized in many of the tables within the baseline documents. A comparison of Figure 2 with a map of the Ohio River drainage in Pennsylvania (Figure 1) reveals that several counties within the basin (Crawford, Erie, McKean, Potter, and Warren) were excluded from the study region. Conversely, Clearfield County is included in the study region even though only 9.9% of its land area is drained to the Ohio River System. Selection of counties for inclusion in ORBES was the result of deliberation by the Core Team, taking into account

TABLE 1

TOPICAL AREAS OF BASELINE FOR THE PENNSYLVANIA ORBES REGION

Part II - Impact Assessment Data Base

- Chapter 1 - Characteristics and Human Utilization of Natural Ecosystems
  - Section 1 - Geology
  - Section 2 - Climatology
  - Section 3 - Soils
  - Section 4 - Terrestrial Ecology
  - Section 5 - Surface Hydrology
  - Section 6 - Water Quality
  - Section 7 - Aquatic Ecology
- Chapter 2 - Socio-Economoc Characteristics
  - Section 1 - Demographic Characteristics
  - Section 2 - Income
  - Section 3 - Employment
  - Section 4 - Housing
  - Section 5 - Governmental Revenues and Expenditures
  - Section 6 - Public and Personal Services
  - Section 7 - Agriculture and Natural Resources
  - Section 8 - Summary of Socio-Economic Charactertistics

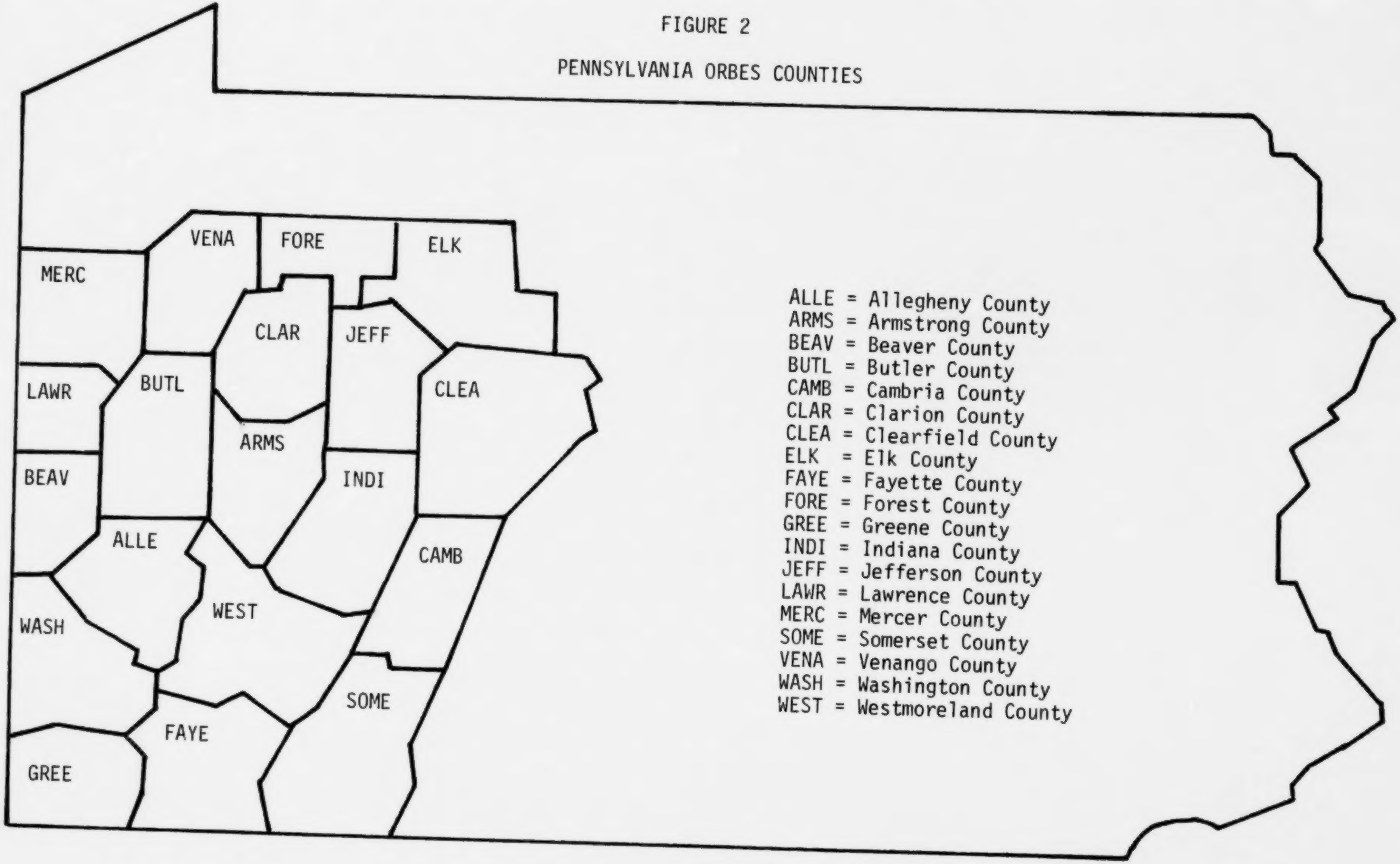
TABLE 2

UNIVERSITY OF PITTSBURGH RESEARCH TEAM
OHIO RIVER BASIN ENERGY STUDY'S
PENNSYLVANIA BASELINE

Burgess, Richard A. Graduate Student Researcher Dept. IEHS	Socio-Economics
Flint, Norman K. Professor of Geology Dept. Geology	Geology, Climatology, and Soils
Kay, George P. Environmental Research Asst. Dept. IEHS	Hydrology, Aquatic and Terrestrial Ecology
Shapiro, Maurice A. Professor Environ. Health Engineering Dept. IEHS	Project Director, Socio-Economics, Hydrology and Ecology
Sharma, Rabinder K. Asst. Professor Public Health Dept. HSA	Socio-Economics
Sooky, Attila A. Assoc. Research Professor - Water Poll. Cntrl. Dept. IEHS	Water Quality and Hydrology
Sykora, Jan L. Assoc. Research Professor - Aquatic Biol. Dept. IEHS	Aquatic and Terrestrial Ecology

FIGURE 2

PENNSYLVANIA ORBES COUNTIES


VENA
FORE
ELK
MERC
CLAR
JEFF
LAWR
BUTL
CLEA
ARMS
BEAV
INDI
ALLE
CAMB
WEST
WASH
SOME
FAYE
GREE

ALLE = Allegheny County
ARMS = Armstrong County
BEAV = Beaver County
BUTL = Butler County
CAMB = Cambria County
CLAR = Clarion County
CLEA = Clearfield County
ELK = Elk County
FAYE = Fayette County
FORE = Forest County
GREE = Greene County
INDI = Indiana County
JEFF = Jefferson County
LAWR = Lawrence County
MERC = Mercer County
SOME = Somerset County
VENA = Venango County
WASH = Washington County
WEST = Westmoreland County

such factors as the potentiality for power plant construction in the area, relative hydrologic importance of the area, and importance of cities outside the basin to the county's economy. In Pennsylvania's case northern counties of the basin were eliminated from consideration because of the low potentiality for future power plants and because of economic influence from Erie, Pennsylvania, and upstate New York.

1.3 A HISTORICAL SYNOPSIS OF HUMAN ACTIVITIES IN WESTERN PENNSYLVANIA

A. Introduction

The earliest European settlers to enter the frontier region west of the Allegheny Mountains were trappers and traders of English and French extraction. English traders appeared in the northern sections of Western Pennsylvania as early as 1720 and the French, moving east from the Mississippi and south from Canada, arrived in southwestern Pennsylvania by 1730.

Migration west from the cities of New York, Boston, and Philadelphia was deflected south because the Allegheny Mountains prevented easy transport of the belongings pioneers carried with them. Migration funneled through the Cumberland Valley into Maryland and Virginia. It was from the western portions of these colonies that English settlers began moving north into Western Pennsylvania. By 1753 Englishmen from Virginia were present in the region surrounding present day Pittsburgh. The French population was still primarily composed of trappers and traders.

Fort Duquesne was constructed in 1754 at the confluence Allegheny and Monongahela Rivers. The major means of transportation from Western Pennsylvania down the Ohio Valley was by water. The location of Fort Duquesne provided a means for the French to control movement down the Ohio River and up the Allegheny and Momongahela Rivers.

General Braddock's ill-fated attempt to capture this French fort did produce the first roadway from Cumberland Maryland to Western Pennsylvania in 1755. General Forbes constructed what was called Forbes Road during a successful expedition against Fort Duquesne in 1759. British supremacy was thereby established in the Upper Ohio River Basin and throughout Western Pennsylvania. Fort Pitt was constructed at the junction of the three rivers to replace the French fort. Thus military protection was provided for the subsequent "formal migration" of Virginians into the area.

Title to the lands of southwestern Pennsylvania was claimed by Pennsylvania and Virginia from 1754 until the formal state line was established in 1784. Although migration to the area decreased during the American Revolution, after the war ended, migration to Fort Pitt came in waves. The area quickly became an important trading link for those moving further west. The area was truely becoming the "Gateway to the West."

Just as the Allegheny Mountains had hindered migration to and through Western Pennsylvania, commodities from the large eastern cities were slow to arrive. Founded on the rich resources west of the mountains with swelling numbers of people settling in and to the west of the area, industry and manufacturing began to grow.

B. Lumber

The first significant industry in Western Pennsylvania was lumbering. As early as 1777 shipbuilding was occurring near the mouth of the Ohio. During the late 1790's Scotch-Irish lumbermen began clearing the extensive hardwood forests of the northern counties. Soft woods from the central and southern sections of Western Pennsylvania also contributed to the rapidly expanding timber industry.

New Englanders came to the area and commercialized lumbering. French-Canadian lumberjacks came south to fell the timber. Small numbers of saw mills sprang up in the areas east of Pittsburgh. The vast water network of the Allegheny, Monongahela and Youghiogheny Basins provided transport for logs and lumber to the Pittsburgh area sawmills. The forests of Venango, Forest, Elk, Clarion, Jefferson and Clearfield Counties swelled with English and German immigrants coming west over the Alleghenys and Scots coming from the south through Pittsburgh. By the end of the 18th century Scotch-Irish immigration occurred in unbroken waves for several years.

The land west of and including Venango County was cleared of oak for farming. The burning of oak produced charcoal and ashes which were sold provided the first commercial enterprises in the northwestern section of the region. Charcoal fed the developing iron smelting industry. Oak ashes, rich in potash, were used in the production of soap and glass, bleaching and drying cloth and the scouring of wool. The northeastern area of the region, the Allegheny plateau with poor soil, winding narrow valleys and cool weather was unsuited to farming. The northwestern area with rolling hills and sandy soils did provide productive agricultural land.

By 1830 the northeastern area had extensive lumbering operations. Wood for homes, ships, barrels, tools and the growing network of rails (ties and railroad cars) was increasing as fast as the timber could be felled. Sawmills and lumber camps dotted the area. Water powered mills and transported timber products. Within twenty to thirty years the timer was gone. The "support enterprises" that grew around the lumbering industry lost their economic base. As the lumbermen moved west economically depressed towns were left behind.

The east central area of the region had a similar fate. The first permanent settlers, Germans and Scotch-Irish arrived in 1791 and the first permanent settlements were established after 1796. The uncertainty of land titles and Indian attacks inhibited large movement into the area. Logs were shipped to Pittsburgh until 1884 at which time the lumbering and tanning industries united in harvesting hemlock stands for local use.

C. Transportation

Early transportation within the region was primarily based upon the area's extensive natural waterways. This water system afforded Pittsburgh the opportunity to develop as the regions major trading and industrial center.

The key to the Pittsburgh-Wheeling competition for regional and western markets was transportation. Goods were shipped from Pittsburgh to New Orleans and in 1801, 450 flatboats carried goods to the port of New Orleans. Return by keelboat was necessary. The downstream trip took 4 to 6 weeks. However, up to 4 months was required to travel the 1,950 mile return trip. Within one decade the steamship changed the nature of water transportation forever. With rapid upstream passage possible, eastern cities shipped goods by sea to New Orleans and from there as far north as Cincinnati. This indirect route was less expensive than transporting goods over the mountains to Pittsburgh for subsequent water transport. The Harrisburg-Pittsburgh Turnpike, opened in 1814, notably stimulated commerce. The impetus given Pittsburgh was undermined however by the completion of the National Turnpike from Baltimore to Wheeling in 1818. Wheeling gained a commanding commercial lead over Pittsburgh. Pittsburgh was further reduced in stature as a commerce center by the completion of the Erie Canal in 1825. Goods could now come from and go to New York City-Buffalo, New York and Erie, Pennsylvania by water. The northern most Pennsylvanian counties began to supply goods to the Erie region rather than to Pittsburgh.

Competition in the East was primarily responsible for the resurrection of Pittsburgh commerce. New York City and Baltimore threatened the commercial interests in Philadelphia. As a result of competition, the Main Line of State Works was developed and the much needed link between Philadelphia and Pittsburgh was established. The Pennsylvania Railroad was chartered in 1845 and linked the two Pennsylvania cities in 1852, the same year the Baltimore and Ohio Railroad reached Wheeling.

The coming of the railroads gave a boost to Pittsburgh commerce and the entire Western Pennsylvania lumbering industry. The expansion of rails west of Pittsburgh, however, spelled disaster for river transport. Rail was a faster means of transport and the expanding markets of the west called for increasingly rapid and more sophisticated transport. Traffic down the Ohio River increased until 1869 and then slowly began to recede. The need for industries to be located on waterways in southwestern Pennsylvania decreased.

D. Oil

The sandy soils of the northern sections of the region held more than agricultural promise (an industry that never was to develop significantly in relation to national production).

As early as 1768 Indians made use of oil. The commercial value of the resource did not develop until the mid 19th century. Whale oil and tallow were the worlds illuminants. By 1830 the world's whale harvests began to dwindle. It was during this period that distillation of crude petroleum to yield kerosene revolutionized home lighting. In 1859 E. L. Drake had Pennsylvania's first oil well in Titusville. By the close of 1860 producing oil wells were located up and down Oil Creek Valley. The Western Pennsylvania "oil boom" was on.

Associated with the expanding oil production were two significant difficulties, oil storage and transportation. Barrels could not be imported fast enough and barrel production became an important satellite industry. Transportation also increased significantly. At its peak, a 2000 vessel fleet of various craft with carrying capacities ranging from 50 to 1500 barrels was moving oil to Pittsburgh. As with lumber, the resource was rapidly depleted. By 1900 the majority of oil was gone. Ghost towns remained where boom towns once stood and poor small communities contained the population remaining. As an example of the rapid change Pitholes stands out. Pitholes grew to a community of 15,000 in a matter of a few months. Within one year the oil was gone and the town was empty.

E. Iron, Steel, and Coal

The manufacturing of iron west of the Allegheny Mountains began in Fayette County as early as 1790. The use of coal and iron in the region was just beginning when the War of 1812 isolated the United States from foreign sources of iron products. This fostered the development of factory systems in the area. It was the growth of the coal, iron and steel industries more than any other resource mix that shaped Western Pennsylvania.

Bituminous coal and iron ore deposits of Clarion, Clearfield and Jefferson Counties formed primary industries during the 19th century. Locally produced pig iron was shipped to Pittsburgh foundries over Red Bank Creek and the Susquehanna and Clarion Rivers. After the Civil War railroads became the primary means of transportation.

The early 19th century iron market was primarily limited to blacksmith shops. The iron products provided by the blacksmiths eventually gave way to wrought iron products; nails, wire fencing, and hardware. The increasing demand for less expensive wrought iron products proved to be an economic advantage for the region. Rich stores of cheap coal and charcoal and, later, coal suitable for coking changed Pittsburgh from a leading commerce center into the nations primary metals center.

The opening of the Great Western Iron Works in 1839 began a 40 year iron boom in the north central section of the region. At the height of activity 40 blast furnaces were operating in the wilderness of Clarion County.

Exploitation of anthracite and soft coals were the most important factors in area industralization. As the availability of charcoal declined and coke fired blast furnaces slowly began to appear throughout the area.

Changes in iron and coking technologies centered the iron and steel making industry in the Pittsburgh area. Originally, most coke was made in "beehive ovens" near coal mines. Volatile by-products were converted for use in production. A process brought into the United States around 1892, coking became centralized and integrated with iron and steel production. The expense of installation and operation of by-product ovens prohibited their construction in the rural areas of the region. The development of Lawrence and Mercer Counties in the 19th century was significantly influenced by the abundance of iron ore, limestone and volatile coal (prior to coking). (The completion of the Erie extension of the Pennsylvania Canal in 1844 connected the majority of area population centers with Pittsburgh and Erie.)

During the development of coking operations and technology the coal and coke of Connellsville, "ideal metallurgical coke," and its proximity to Pittsburgh were critical in pushing the city ahead of other iron and steel producing centers of the nation. The last quarter of the 19th century saw Pittsburgh take a commanding lead. In 1875 Carnegie's Edgar Thompson Works, the first integrated steel works in the region was built, followed by the Homestead Works in 1881.

The area population began expanding rapidly, a 40% increase between 1860 and 1910. 45% of all employment was in manufacturing. By 1910 more than 80,000 miners were employed. The population in the Pittsburgh area grew from 409,000 in 1850 to 1,039,000 in 1900. Immigrants were brought into the area by the thousands to fill the demand for laborers. A quarter of the 1900 population was composed of foreign born individuals.

The Bessemer steel making process was patented in Johnstown, Pennsylvania in 1858. The city's major industry quickly became steel making. The Bessemer Process was observed in England by Andrew Carnegie and brought into the Pittsburgh Region. The Johnstown steel rolling mills stimulated growth in the area in employment and coal mining, fire brick production and transportation industries benefited.

The industrial peak for the region in general and Pittsburgh in particular lasted from 1870 to 1900.

Innovations in steel making adversely affected Pittsburgh's position as a primary metals center. The advantage of proximity to Connellsville was lost as coking requirements for steel were reduced 25% and advances in coke processing technology permitted use of lower quality coals from West Virginia and Kentucky.

The declining growth rate of railroads cut heavily into the demand for steel. A shift in demand for other commodities precipitated the decline in Pittsburgh's share of the steel and iron markets.

The cost associated with the commodities coming into demand resulted in the basic metal price becoming a smaller portion of total costs. Thus cost considerations shifted from the primary metals to other costs and permitted less centralized steel and iron markets to form.

Although mill capacity increased the market share held by Pittsburgh declined. The ingot capacity on a national level decreased from 1/3 or total ingot capacity supplied in 1898 to 1/4 in 1920, 1/5 in 1945 and less than 1/6 in 1960.

Coupled with the changes in the steel and iron markets was a concurrent decline in coal mining. After World War 1 two factors contributed to the economic depression of the region.

First, a switch from coal to oil and gas home heating cut deeply into the demand for coal. Secondly, the increasing mechanization of the mining industry caused increasing unemployment.

In 1941, 90 million tons of coal were mined by approximately 83,000 miners. By 1964 production dropped to 48 million tons and employment to 16,000 miners. Although 1966 estimates indicated 36 billion tons of coal reserves existed only 17,800 miners were at work and this level of employment represented an increase over the few preceeding years.

PART 2 - IMPACT ASSESSMENT DATA BASE

2.1 CHARACTERISTICS AND HUMAN UTILIZATION OF NATURAL ECOSYSTEMS

2.1.1. TOPOGRAPHY AND GEOLOGY

2.1.1.1. TOPOGRAPHIC CHARACTERISTICS

A. Introduction

The ORBES Region of Pennsylvania lies in the Appalachian Plateaus Physiographic Province (Fig. 2.1.1.-1). This province is bound on the east by the "Allegheny Front," a topographic boundary between the plateau to the west and the Ridge and Valley Province to the east. The plateau is sub-divided into four sections: (1) the Pittsburgh Plateaus Section, (2) the Allegheny High Plateaus Section, (3) the Glaciated Section, and (4) the Allegheny Mountain Section.

B. Pittsburgh Plateaus Section

The major part of the ORBES Region is in the Pittsburgh Plateaus Section. This section includes all or part of the counties of Allegheny, Armstrong, Beaver, Butler, Cambria, Clarion, Clearfield, Fayette, Greene, Indiana, Jefferson, Venango, and Washington. It is well-dissected and hilly, with relief on the order of 300 to 500 feet. Steep slopes are common.

Dendritic drainage is prevalent. Major streams are the Monongahela and Allegheny Rivers which join at Pittsburgh to form the Ohio River (Fig. 2.1.1.-2). An important tributary of the Ohio River is the Beaver River. The Beaver is formed where the Mahoning River joins the Shenango River near New Castle in Lawrence County, and from there flows southerly to the Ohio River at Rochester about twenty miles downstream from Pittsburgh. A principal tributary of the Beaver is Slippery Rock Creek, a stream that drains much of northern Butler County in the Glaciated Section of the plateau. Slippery Rock Creek is joined by Connoquenessing Creek a few miles east of the Beaver River. Connoquenessing Creek and its tributaries drain most of the southern part of Butler County.

The Ohio River is a major stream of the area. From Pittsburgh it takes a northwesterly course for about 20 miles to Beaver where it turns southwesterly to form the Ohio-West Virginia boundary. The rather abrupt change in the flow direction of the Ohio River at Beaver is the result of diversion of the river in glacial time. Pre-glacially, the ancestral "Monongahela" flowed to Pittsburgh as it now does, and then on to Beaver where it continued northward along the course of what is now the southerly flowing Beaver River to the Lake Erie basin near Ashtabula, Ohio. When glacier ice blocked this northerly flow the stream was forced to seek another direction which was southwesterly along the course of the present Ohio River. A similar diversion occurred in the upper Allegheny River. Pre-glacially, the ancestral "upper Allegheny River" flowed through Olean, New York northwesterly to the Lake Erie basin, but because of ice-blocking was forced to take the southwesterly course that the present Allegheny now flows in flowing from Warren (Warren County) through Tionesta (Forest County) to Franklin in Venango County. French Creek, a tributary of the Allegheny, was also involved in a reversal of flow because of glaciation. French Creek now flows southeasterly through Meadville (Crawford County) and then to the Allegheny River at Franklin, but in pre-glacial time, French Creek was a northwesterly flowing stream that emptied into the Lake Erie basin. Thus, it is a stream whose flow direction has been reversed. From the Clarion River downstream the Allegheny River follows essentially the same course now that it did prior to glaciation. Neither the present Monongahela River nor its tributaries have realized any appreciable changes in flow direction because they occur south of the glaciated area and therefore were not directly affected by glacier ice.

C. Glaciated Section

The northwestern part of the Pennsylvania ORBES Region lies in the Glaciated Section of the Allegheny Plateau (Fig. 2.1.1.-1). This is mainly in Mercer and Lawrence Counties but also includes parts of Venango, Butler, and Beaver Counties. Glacial drift covers the bedrock in this section. The thickness of the drift ranges from a few feet in hilltop areas to several hundred feet where pre-glacial valleys have been filled or partly filled. Local relief in this section is moderate, on the order of 100 feet or so, and although some steep slopes occur, in general slopes are considerably more gentle than those in the Pittsburgh Plateaus Section. Various types of glacial landforms and deposits are present. They include ground moraines, end moraines, kames, kame terraces, kame moraines, eskers, and outwash deposits in valleys. Swampy, poorly drained terrain is common. The drainage pattern overall is dendritic but locally there are deranged patterns caused by glaciation. The dominant drainage direction in Mercer and Lawrence Counties is southerly by means of Shenango River, Neshannock Creek, and Beaver River. Slippery Rock Creek and its tributary, Wolf Creek, also drain a large segment of the glaciated terrain. Muddy Creek, a Slippery Rock Creek tributary, is of interest because it is in Muddy Creek valley that a man-made lake (Lake Arthur) was created in 1969 for recreational purposes in the same basin that contained a natural, glacial lake in Pleistocene time. Lake Arthur, the modern lake, has been reestablished at a somewhat lower water level than the ancient lake by the construction of an earth-fill dam near the site where glacier ice once blocked the flow of Muddy Creek. Other notable bodies of water occur just outside the boundaries of the ORBES Region but within the Ohio River drainage basin in Crawford County. These are Pymatuning Reservoir and Conneaut Lake. Pymatuning Reservoir is the result of the damming of Shenango River. This reservoir also extends into Ashtabula County, Ohio. Conneaut Lake is a natural glacial lake in a valley tributary to French Creek valley. Both bodies of water occur in valleys partly filled with glacial drift.

Notable tributaries entering the Ohio River from the south are Chartiers Creek and Raccoon Creek, both having their headwaters in Washington County. Chartiers Creek also flows through southern Allegheny County and joins the Ohio River downstream from Pittsburgh at McKees Rocks; Raccoon Creek flows through southern Beaver County to join the Ohio about 10 miles upstream from the Pennsylvania-Ohio boundary.

Allegheny River enters the Pennsylvania ORBES Region from the north. Its headwaters are in Potter County in the Coudersport drainage area. From there it flows northwesterly into New York through Olean where it turns and takes a southwesterly course to Pittsburgh. It is the main stream of the northern part of the ORBES Region. Principal tributaries of the Allegheny are the Kiskiminetas River (a stream formed by the joining of Loyalhanna Creek and the Conemaugh River), Crooked Creek, Mahoning Creek, Redbank Creek, and the Clarion River.

The Monongahela River, the major stream in the southern part of the ORBES Region, enters Pennsylvania from West Virginia and flows northerly, forming the boundary between Greene County and Fayette County, and also between Washington County and the southwest corner of Westmoreland County. From there it flows through southern Allegheny County to Pittsburgh. An important tributary of the Monongahela is the Youghiogheny River. This stream's headwaters are in western Maryland. From there the Youghiogheny flows northwesterly through the mountainous section of the Plateaus Province in Pennsylvania to join the Monongahela at McKeesport. Western tributaries of the Monongahela are Tenmile Creek in Washington County and Dunkard Creek in Greene County. An eastern tributary is Turtle Creek whose valley is heavily industrialized. Turtle Creek flows into the Monongahela at East Pittsburgh 11 miles upstream from the Point in Pittsburgh where the Monongahela joins the Allegheny to form the Ohio River.

D. Allegheny High Plateaus Section

The northern tier of counties in the Pennsylvania ORBES Region (Venango, Forest, Elk, and northern Clearfield) lie in the Allegheny High Plateaus Section. This section is characterized by hilly terrain and steep slopes. It is largely a forested area of fairly sparse population. Summit elevations of 1,900 to 2,000 feet are common as compared to ones in the 1,400- to 1,500-foot range in the Pittsburgh Plateaus Section. Also, local relief is relatively high in the High Plateaus Section, being on the order of 600 to 800 feet in areas adjacent to major stream valleys. The area of eastern Elk County and most of Clearfield County is part of the High Plateaus drained to the east by Sinnemahoning Creek and the West Branch of the Susquehanna River. The major part of Clearfield County, lying in the Pittsburgh Plateaus Section, is in the drainage basin of West Branch of Susquehanna River (note drainage divide Fig. 2.1.1.-2), and is not part of the Ohio drainage system.

E. Allegheny Mountain Section

The southeastern part of the region is located in the Allegheny Mountain Section of the Appalachian Plateaus Province. Terrain in the Mountain Section has a pronounced linear aspect not found in other sections. This linearity owes its presence to three parallel anticlinal mountains of northeast trend; Chestnut Ridge, Laurel Hill, and Negro Mountain; and one homoclinal mountain of the same trend known as Allegheny Mountain. Allegheny Mountain forms the "Allegheny Front" whose summit elevation is about 1,000 feet higher than elevations in the adjacent valley to the east at the western edge of the Ridge and Valley Province. Summit elevations of the Allegheny Front are highest in Somerset County (about 3,000 feet) and get progressively lower northeastward. At the Clearfield County-Cambria County boundary, the summit elevation is about 2,600 feet.

The Allegheny Front is a continuous feature along most of the east edge of the ORBES Region but the three anticlinal ridges die out as prominent topographic features to the northeast. Chestnut Ridge dies out as a conspicuous ridge in the vicinity of Blairsville although it is a noticeable feature beyond there into the Indiana-Clymer area of Indiana County. Laurel Hill also terminates as a prominent ridge in Cambria County in the vicinity of Nanty Glo. Negro Mountain is prominent only in southern Somerset County in the area of Mt. Davis, the highest point in Pennsylvania (3,213 feet). These anticlinal ridges become less evident to the northeast because the anticlines plunge in that direction. Although Chestnut Ridge anticline and Laurel Hill anticline are not manifested as such conspicuous ridges in the northeast part of the ORBES Region as in the southeast part, the structures do exist in Clearfield and Elk Counties where they impart a less noticeable linearity to the terrain of the High Plateaus Section of the Allegheny Plateau.

In southern Somerset County and adjacent Bedford County the Allegheny Front jogs to the east by about 10 miles, and the mountain forming the Front there is known as Little Allegheny Mountain. The Somerset County-Bedford County boundary line follows the summit of this mountain whose southern extension into Allegany County of western Maryland is known as Dans Mountain. Drainage in this extreme southeastern part of the ORBES Region is in the Potomac system. Wills Creek is one of the streams in this system. Little Allegheny Mountain and its southern extension, Dans Mountain, is a homoclinal ridge on the east flank of the Georges Creek syncline. The counterpart homoclinal ridge on the west flank is Savage Mountain. Because the syncline plunges to the southwest, these homoclinal ridges converge in the northeast direction and form a synclinal nose in southern Somerset County. It is at the site of this nose that the Allegheny Front makes the jog to the east.

Local relief in the Allegheny Mountain Section is in the 1,000- to 1,500-foot range where major streams have cut gorges through the anticlinal ridges. The Conemaugh River gorges through Laurel Hill west of Johnstown and through Chestnut Ridge east of Blairsville are notable. Other prominent gorges are the Loyalhanna Creek gorge through Chestnut Ridge east of Latrobe; Youghiogheny River gorge through Chestnut Ridge between Ohiopyle and Connellsville. Also, Casselman River, which is a Youghiogheny River tributary, flows through a gorge in Negro Mountain more than 500 feet deep. The highest point in Pennsylvania (3,213 feet) occurs about 5 miles south of this gorge at Mt. Davis, a slight local prominence on Negro mountain whose summit elevations in that area are generally in the 3,000- to 3,200-foot range.

Streams in this section in part follow the northeast-southwest trend of synclinal valleys and in part cut transversely across anticlinal ridges and synclinal valleys. The Conemaugh River whose headwaters are on the west slopes of Allegheny Mountain is a transverse stream that cuts across several folds in flowing to Blairsville. Youghiogheny River, in its upper reaches in western Maryland and Somerset-Fayette Counties, Pennsylvania follows the trend of the Youghiogheny syncline to Confluence, but from there turns northwesterly and becomes a transverse stream. Casselman River is unique in that it flows northeasterly along the trend of the Meyersdale syncline from western Maryland to Meyersdale, Pennsylvania where it turns northwesterly and crosses Negro Mountain anticline. At Rockwood, the stream turns southwesterly and roughly follows structural trend to its junction with the Youghiogheny River at Confluence, thus making a broad U-turn in its course of flow. Another stream that joins the Youghiogheny at Confluence is Laurel Hill Creek, a southerly flowing stream. Indian Creek is a stream in the Ligonier syncline as is Loyalhanna Creek before turning northwesterly at Ligonier to become a transverse stream.

There are several water impoundments in the Allegheny Mountain Section. The largest is Youghiogheny Reservoir, a combined flood-control and recreational facility in Somerset County, Pennsylvania and Garrett County, Maryland. The Youghiogheny dam is located near Confluence, Pennsylvania. Another reservoir is Quemahoning Reservoir in Somerset County on a tributary of the Conemaugh River south of Johnstown.

2.1.1.2 GEOLOGIC CHARACTERISTICS

A. Geologic Structure

In the ORBES Region of Pennsylvania the exposed bedrock ranges from Upper Devonian through Permian. The younger, Permian rocks occur in the southwest corner of the state. From there south-southeastward, older and older rocks crop out, down through the sequence of Pennsylvanian and Mississippian to the Devonian (Fig. 2.1.1.-3). This is because the strata are rising gently in the up-plunge direction of the Pittsburgh-Huntington basin. The most widely distributed surface rocks in this basin are the coal-bearing rocks of the Pennsylvanian System. Pleistocene glacial deposits cover the bedrock in the northwestern part of the area. The mineral resources of the area include coal, oil, gas, limestone, clay and shale, sandstone, sand and gravel, and ground water. Principal geologic hazards are landsliding, subsidence from coal-mining, and flooding. Seismic risk is minimal.

The Pennsylvania ORBES Region lies in a high trough known as the Pittsburgh-Huntington basin (Fig. 2.1.1.-4) whose axis trends southwesterly through Pittsburgh to Huntington, West Virginia and into eastern Kentucky. In Pennsylvania this basin has a southwesterly plunge causing rock strata to have an overall gentle inclination in that direction. This is why relatively young Permian strata are present in Greene and Washington Counties in the southwest corner of the state whereas older beds appear at the surface to the northeast (Fig. 2.1.1.-3). However, this regional southwesterly dip is dominated in the western counties by a southeasterly dip that extends from eastern Ohio into western Pennsylvania. Superimposed on the gentle southwesterly plunge of the Pittsburgh-Huntington basin are several northeast-trending folds that are most prominent in the southeastern, Allegheny Mountain Section of Appalachian Plateaus (Figs. 2.1.1.-3, 4, 5). Along the axial trends of these prominent anticlinal folds Mississippian strata crop out in rather extensive areas, and here and there Upper Devonian beds are also exposed along the same trends. West of Chestnut Ridge, the westernmost of these prominent anticlinal folds, there is a continued succession of northeast-trending anticlines and synclines as far west as Pittsburgh. These folds become ever more gentle to the west and do not exert any marked effect on either outcrop areas or topography west of Chestnut Ridge. Strata in much of the region are essentially flat-lying, that is they dip at an angle of less than one degree.

In Mercer, Venango, Clarion, Butler, Lawrence and Beaver Counties, and in most of Allegheny, Washington, and Greene Counties there is a southeasterly dip that averages about 60 feet per mile (a little more than ½ degree). This dip is locally modified by minor doming, particularly near the axis of the basin close to the more highly folded strata on the eastern limb. Map #9 (Appendix I) is a structure contour map that shows the structure of the entire ORBES Region. A more detailed structure contour map, Map #43 (Appendix I), shows the structure in six southwestern counties in the so-called Greater Pittsburgh Region which includes Allegheny, Armstrong, Beaver, Butler, Washington, and Westmoreland Counties.

The eastern limb of the Pittsburgh-Huntington basin is complicated by anticlinal and synclinal folds which are most prominent in the southeast part of the region in Somerset, Fayette, and Westmoreland Counties. These folds are depicted in the structure section, Figure 2.1.1.-5. The folds are also present in other eastern counties but are less intense there (Cambria, Indiana, Armstrong, Jefferson, Clearfield, and Elk Counties) and do not dominate the topography as much as in the southeast area. The amplitude or structural relief of the folds increases from west to east. In the vicinity of Pittsburgh, near the axis of the basin, folds have an amplitude on the order of 350 feet whereas Chestnut Ridge, Laurel Hill, and Negro Mountain anticlines to the east have an amplitude in the 2,000- to 3,000-foot range. Spacing of the axes of the major structures is from 10 to 15 miles apart. Axial traces of folds in the southeastern area are relatively straight, but become increasingly sinuous to the west.

Although the dominant structural trend by far is a northeasterly trend, "cross-structures" having a west-northwest orientation are recognized. An example is Cross Creek syncline in Washington County (see Map #43, Appendix I). Also, "lines of structural discontinuity" occur in Butler County as west-northwest-trending zones "along which fold axes terminate, diminish, or change direction." These have been referred to by Briggs and Kohl as "Wagner-Lytle Lines" which are thought to be indicators of oil and gas fields. There is speculation that these cross-structures may be "the expression of long-lived, very slowly and intermittently moving strike-slip faults in crystalline basement."

Faults are common, at least in the subsurface, in the eastern part of the region, but are virtually unknown in the western part. In the eastern area of folded rocks, faults are associated with the folds. Some faults are parallel or subparallel to the trend of the folds, and others are transverse. Generally speaking, surface evidence of faulting is not plentiful, but oil- and gas-well drilling provides subsurface evidence. There is surface evidence of faulting, however, in Clearfield County where a notable area of transcurrent (wrench) faulting occurs near the east edge of the Plateau. These faults are identified by recognizing offsets in surface coal beds and associated strata. Some faults that parallel the structural trend can be traced in the subsurface for a distance of 10 to 20 miles (see Map #9, Appendix I); others can be traced for less than a mile. Vertical displacements are not large. They are commonly on the order of 100 to 200 feet. Evidence of the horizontal displacement of transverse faults is generally lacking but it too is thought to be relatively small. In the ORBES Region there are no known major faults that extend for several tens of miles and have a displacement of thousands of feet as in some of the more tectonically disturbed areas of the United States.

B. Stratigraphy

Exposed bedrock strata in the ORBES Region range from Upper Devonian to Permian (see Fig. 2.1.1.-6). These strata are sedimentary rocks consisting mainly of shale, sandstone, siltstone, limestone, coal, and clay. Shale and sandstone are most abundant but other rocks that comprise only a small percentage of the total are of more economic value. These include certain coal, limestone, and clay beds. Various subsurface strata of Mississippian and Devonian age are reservoir rocks for oil and gas. They are primarily sandstones, but one cherty formation (Huntersville chert) is also a gas producer.

Considering the stratigraphic column as a whole and the occurrence of commercially important resources within it, the lower beds (Upper Devonian and Mississippian) contain the productive oil and gas reservoir rocks and the upper part of the Mississippian contains the siliceous Loyalhanna Limestone which is quarried extensively for aggregate stone in the Allegheny Mountain Section. The resistant Connoquenessing and Homewood sandstones of the Pottsville Group provide some of the more scenic terrain, for example, the gorge of Slippery Rock Creek at McConnell's Mill State Park in Lawrence County. The Allegheny Group has the Vanport limestone, the only source of flux stone for steel-making in western Pennsylvania. This group also contains several mineable coal seams. The Conemaugh Group has several claystone units that are landslide prone; the Monongahela Group has mineable coal beds including the famous Pittsburgh seam; and both the Monongahela and Dunkard Groups have shales, shaly limestones, and calcareous shales that are landslide prone.

Quaternary beds consist of unconsolidated Pleistocene glacial deposits plus recent alluvial deposits in stream valleys. These unconsolidated materials cover bedrock of different ages ranging from Upper Devonian to Pennsylvanian, depending on the locality within the region.

C. Coal Resources

The ORBES Region lies within the Main Bituminous Coal Field of Pennsylvania (see Fig. 2.1.1.-7). The Georges Creek Coal Field of Somerset County in the southeastern corner of the region is also included. A small, relatively unimportant part of the main field lies outside the ORBES Region, in Cameron, Clinton, and McKean Counties. Coal reserves in the latter three counties are small compared to those in other counties of the region.

Coal rank ranges from low-volatile bituminous in parts of Somerset and Cambria Counties through medium-volatile bituminous in other parts of Somerset and Cambria Counties and also in parts of Fayette, Westmoreland, and Clearfield Counties to high-volatile bituminous in all other counties of the region, The higher rank coal occurs in the eastern part, the lower rank coal in the western part of the region. In the high-rank coal area of Somerset and Cambria Counties the fixed carbon content of coal on the dry, ash-free basis is up to 85%. This percentage decreases westerly to 57% at the Ohio border. In the Georges Creek Field the coal has a fixed carbon percentage of about 80%.

The heat value of the coal ranges from an average low of 14,700 Btu/lb in Beaver and Lawrence Counties to an average maximum of 15,800 Btu/lb in northern Somerset County, south Cambria County, and in the Georges Creek Field.

Coal seams of the Main Bituminous and Georges Creek Coal Fields are shown in Figure 2.1.1.-9. There are 12 principal mineable seams indicated in bold type. The areal distribution and thickness of these seams plus one other (Washington coal) are shown in Plates 1 through 13 (Appendix II). The major mineable seams occur in the Allegheny and Monongahela Groups which are widely distributed in the region. Mineable coal seams of lesser importance, in the Pottsville Group, occur principally in Lawrence and Mercer Counties whereas those of the Conemaugh Group are confined mainly to Somerset County, particularly in the relatively small Georges Creek basin.

Recoverable coal reserves in the Main Bituminous and Georges Creek Fields as of January 1, 1979 are shown by county on the coal fields map of Pennsylvania (Fig. 2.1.1.-7). These reserves are also presented in Table 2.1.1.-1 not only by county but also by thickness category and coal rank. Recoverable coal is defined as that which can be extracted and marketed. In these estimates it excludes coal less than 24 inches thick and coal that will be lost in mining (an estimated 37%). Counties having the largest in-place reserves as of June 1, 1970 are Washington, Greene, Indiana, Somerset, Fayette, Westmoreland, and Cambria Counties, in that order. The northern tier of counties (Mercer, Venango, Forest, Elk) has a comparatively small coal reserve.

The principal mining activity has been in Fayette, Allegheny, Westmoreland, Washington, and Cambria Counties (see Table 2.1.1.-2). Much of the mining in the first four of those counties was in the Pittsburgh coalbed, whereas in Cambria County mining has been mainly in Lower and Upper Kittanning and the Lower and Upper Freeport coalbeds. Remaining reserves in the Pittsburgh coalbed as of 1970 are shown in Table 2.1.1.-3.

Reserves of strip-mineable coal have been calculated for 16 of the 19 ORBES counties. In the other 3 counties (Elk, Forest, and Venango) reserves are very minor. The estimated strippable coal reserves are presented in Table 2.1.1.-4 and Figure 2.1.1.-8 which show county-by-county reserve estimates. These estimates are based on the amount of remaining coal having 120 feet or less overburden. It is notable that Butler County is the number one county with respect to reserves of strip-mineable coal. Reserves of strippable coal on an individual seam basis are presented in Table 2.1.1.-5. Table 2.1.1.-4 shows the reserves in each of 18 mineable beds and Table 2.1.1.-5 shows reserves for each of the 16 counties of southwestern Pennsylvania on a seam-by-seam basis. In general the coal beds of the Allegheny Group contain the largest reserves. These include the Brookville and Clarion coalbeds; the Lower, Middle, and Upper Kittanning; and the Lower and Upper Freeport seams. The Waynesburg coalbed of the Dunkard Group also has large reserves. Areas in which these coal seams are susceptible to strip-mining can be inferred in a general way from the "distribution and thickness" maps of Plates 1 through 13 (Appendix II). On those maps the outcrop trace of a given coal bed is represented by the boundary between a colored area and an uncolored area (white). Strip-mining will be done within the colored areas close to their boundary with uncolored areas. Mining will start at the outcrop and extend into the colored areas (into hillsides) until the overburden becomes prohibitively thick.

No coal seam in the Pennsylvania ORBES Region is known to have an average sulfur content of less than one percent without beneficiation (Edmunds, 1972) and thereby classify as "low sulfur" coal. However, some coal seams in some parts of the region are in the "medium-sulfur" category (1% to 2%). Other seams which contain more than 2 percent sulfur fall in the "high-sulfur" coal category. Table 2.1.1.-6 shows the sulfur content by seam of the strippable coal reserves of all ORBES counties except Elk, Forest, and Venango. It should be noted that the sulfur data in this table are based on average sulfur content of coal seams in each county and do not take into account local areas within which the sulfur percentage may be lower or higher than the reported value. No published sulfur data are available for deep-mine coal, but it is expected that the sulfur content of such coal largely conforms to that of strip-mine coal.

D. Oil and Gas Resources

The distribution of oil and gas fields in Pennsylvania is shown on Map #10 of the Pennsylvania Geological Survey (Fig. 2.1.1.-10). These fields appear in more detail on the Survey's Map #3 (in Appendix III) which also shows gas storage fields and principal gas pipelines in the region. The names of oil and gas fields and pools, including ones in which gas is stored, are all listed on Map #3. More than 50 gas-storage fields are located in the ORBES Region. These are fields from which gas has been previously extracted and are now being used for underground storage of pipeline gas from other producing areas mainly. Gas in these storage reservoirs is available on a demand basis particularly in winter months when domestic heating is at a maximum.

Reservoir rocks that contain oil and gas are shown in their stratigraphic position in Figure 2.1.1.-6. A distinction is made in Pennsylvania between deep production and shallow production of oil and gas. The so-called shallow production is from reservoir rocks of Middle Devonian age or younger. As can be seen on Map #3 and Figure 2.1.1.-10, deep-reservoir gas fields are in general located in the eastern part of the region, shallow-reservoir gas fields are in the central part, and shallow-reservoir oil fields are in the western part. There is a general northeast trend of oil- and gas-bearing areas. This trend is more pronounced in easterly areas than in westerly ones because anticlinal folds which are responsible for the trapping of gas in "pools" are more pronounced to the east.

Cumulative oil production in Pennsylvania through 1976 is 1,289,564,000 barrels (Lytle, 1977). In 1976 the production was 2,950,000 barrels (see Fig. 2.1.1.-11) about half of which came from the Bradford field in McKean County outside the ORBES Region. Reserves of oil in Pennsylvania (1976) are estimated at 50,563,000 barrels (see Table 2.1.1.-7). Much of this reserve probably occurs in McKean County.

Cumulative natural gas production in Pennsylvania through 1976 was 9,013,560 million cubic feet (Table 2.1.1.-7), a large part of which was from the ORBES Region. Figure 2.1.1.-12 shows that gas production in 1976 was not significantly different from that in 1946. Production was generally higher in the 1950's than in other decades; peak production in the period since 1946 occurred in 1954. Proved recoverable reserve estimates of "native" gas (exclusive of stored gas from other areas) are also shown in Figure 2.1.1.-12. Except for a decrease in the 1950's, these reserves increased in the period between 1948 and the end of 1967, and showed an overall decrease from 1967 to 1974. If both native gas and stored gas are considered together, Pennsylvania's total proved recoverable reserves showed an overall increase in the period from 1946 through 1975.

E. Other Mineral Resources

Mineral resources other than coal and oil and gas include limestone, clay and shale, sandstone, and sand and gravel. These are exploited principally by open-pit mining although there is some underground mining. A 1976 Mineral Producers Map of Pennsylvania by O'Neill (Plate 1 of Pa. Geological Survey Information Circular 54, 1977; in Appendix IV) shows the distribution of these operations and lists by county the mineral operations. There is a clustering of clay mines in Clearfield County and in the Beaver-Lawrence County area, a clustering of sand and gravel operations in Lawrence, Butler, Mercer, and Venango Counties (the glaciated area) and along the Allegheny River valley where glacial outwash deposits are present in the stream bed and also in both low-level and high-level terrace deposits. There are two principal areas of limestone mining. One is in Butler and Lawrence Counties where the high-calcium Vanport limestone (Pennsylvanian) is mined; the other is along Chestnut Ridge in Fayette and Westmoreland Counties where most of the siliceous Loyalhanna limestone (Mississippian) quarries are located. Sandstone operations, which are less abundant, show no particular concentration in any one area.

Each of these mineral resources is discussed more fully in the following paragraphs.

The principal limestone units exploited in the Pennsylvania ORBES Region are the Vanport limestone of the Pennsylvania Allegheny Group and the Loyalhanna limestone of the Mississippian System (see stratigraphic column, Fig. 2.1.1.-6). The Vanport is the only source of high-calcium limestone (90% to 96% $CaCO_3$) in western Pennsylvania. It is used as flux stone in the iron and steel industry, in making cement, and as agricultural limestone, aggregate stone, and roadstone. The Loyalhanna, on the other hand, is siliceous (sandy) limestone composed of about half-and-half calcium carbonate and quartz sand. It makes good quality aggregate stone that is used extensively as base or sub-base roadway material, in making concrete, and as railroad ballast. An overall view of areas in which the Vanport limestone and Loyalhanna limestone are worked is presented in Figure 2.1.1.-13 (Map #15 of the Pa. Geological Survey). The distribution and thickness of the Vanport limestone are shown in detail on Map #4 of Bulletin M 50, Part I of the Pennsylvania Geological Survey (in Appendix V). This is a map showing areas in which the limestone is either at the surface or close enough to it to be economically mined by open-pit or shallow underground methods. The limestone is also present in some areas south of that representing the mineable area, but is too deeply buried to be exploited. It does not exist to the north where it has been eroded away, leaving the older underlying rocks exposed. Typical thicknesses of the Vanport limestone in its workable area are in the 15- to 20-foot range. It attains an uncommon thickness on the order of 40 feet near Elliott Mills in Lawrence and Butler Counties. The principal reserves of Vanport limestone 15 feet or more thick are in Butler, Armstrong, Lawrence, Beaver, and Clarion Counties. Estimated reserves in these counties as of 1964 (O'Neill, 1964) were as follows:

County		Reserves (tons)
Butler		13,300,000,000
Armstrong		3,700,000,000
Lawrence		2,050,000,000
Beaver		30,000,000
Clarion		20,000,000
	Total	19,100,000,000

In 1976 there were 13 active limestone operations in the Vanport limestone, two of which were underground mines; the remaining 11 were quarries. One of the quarries is in Butler County, 3 in Lawrence County, 2 in Clarion County, and 1 in Armstrong County. There was no quarrying of Vanport limestone in Beaver County in 1976.

The Loyalhanna limestone is accessible for quarrying only in the southeastern part of the region where it crops out along Chestnut Ridge, Laurel Hill, and Negro Mountain anticlines in Fayette, Westmoreland, and Somerset Counties (Fig. 2.1.1.-13). There are 8 active quarries, all but two of which are on Chestnut Ridge; one of the others is on Laurel Hill (Somerset County) and the remaining quarry is on the breached crest of Negro Mountain anticline near Mt. Davis, the highest point in Pennsylvania (3,213 feet), in Somerset County. Three of the Chestnut Ridge quarries are in Fayette County and 3 are in Westmoreland County. The main reason for this concentration of Loyalhanna limestone quarries on Chestnut Ridge is because that area is closer to the primary markets for crushed stone to the west than are the Laurel Hill and Negro Mountain areas.

The thickness of the Loyalhanna in areas where it is quarried is approximately 50 feet. It is commonly referred to as "blue stone" because of its bluish-gray color. It is high quality stone for use in road construction, being classified by the Pennsylvania Department of Transportation (PennDOT) as Type A roadstone. Reserves of Loyalhanna limestone amenable to quarrying are estimated at 47 million tons in the Chestnut Ridge district and 85 million tons in the Laurel Hill district (O'Neill, 1964). No reserve estimates have been published for the Negro Mountain area.

Clay and shale are used in the Pennsylvania ORBES Region for making refractory products, stoneware, and cement. Clay used in refractories occurs as underclay of coal beds (fireclay) in the Allegheny and Pottsville Groups primarily. Some of this is plastic fireclay and some is flint fireclay. The more important clay beds are the Mercer clay (Pottsville) and the Brookville, Lower Kittanning, Bolivar, and Upper Freeport clay of the Allegheny Group (see stratigraphic section, Fig. 2.1.1.-6). Shale suitable for making common bricks, sewer pipe, tile, etc. occurs at several stratigraphic levels in the Allegheny and Conemaugh Groups. It is more widely distributed than fireclay, although shale operations are few in number compared to clay operations.

Clay and shale are mined chiefly by open-cut methods but the number of underground mines is substantial. The ratio of open-cut to underground mines is approximately 4 to 1. Clearfield County has about 25 open-pit clay mines where the Mercer and Clarion fireclays are the principal clay beds. Lawrence and Beaver Counties have about one-half that number of fireclay mines. The chief clay beds mined in that area occur in the Allegheny Group. The lower Kittanning clay is the most important of these clay beds.

Sandstone operations are not extensive in the Pennsylvania ORBES Region. There are about a dozen sites where sandstone is worked for the production of crushed stone and broken stone for uses such as aggregate, construction stone, sand blasting, foundry sand, engine sand, and riprap. The sites are scattered through the region. At one locality (West Winfield, Butler County) sandstone is produced from an underground mine along with the Vanport limestone but at other places it is produced from quarries. The main restriction on extensive exploitation of sandstone in the region is the lateral variability of sandstone units, both in quality and thickness. They are prone to change over fairly short distances from thick-bedded or massive sandstone to shaly sandstone. Also, their thickness may change locally from 40 to 50 feet to less than half that.

Sand and gravel for commercial use is found in several types of deposits. It occurs in the channels of the major rivers (the Allegheny, Ohio, and Beaver), as low-level terrace and high-level terrace deposits along those rivers, and in kame terraces, kame moraines, and eskers within the glaciated area. Rivers in the southern part of the region like the Monongahela, Youghiogheny, and Kiskiminetas are not sources of this material because they have never been the sites of glacial outwash deposition like rivers in the northern part of the region. Sand and gravel is used extensively in the ORBES Region in the construction industries, particularly in road-building where large quantities of concrete are used. Although sand and gravel is relatively plentiful, there are land-use conflicts that significantly reduce the areas in which this product can be exploited.

The location of sand and gravel operations is shown in Plate 1 of the Pennsylvania Geological Survey's Information Circular 54 (in Appendix IV). Numerous operations occur along the Allegheny River valley in Allegheny, Armstrong, Clarion, Venango, and Forest Counties. Others are present in the Ohio River valley in Beaver County, and the Beaver River valley of Beaver and Lawrence Counties. Sand and gravel is produced by dredging in some of these operations where deposits either in the present stream channel or on the "low-level" terraces are being worked. Where the "high-level" terrace deposits are worked, open-pit techniques are used. These high-level deposits occur on terraces about 200 feet above the present streams. The deposits are glacial outwash material laid down on the valley bottoms, presumably in Illinoisan glacial time before the valleys had been deepened to their present level. The deposits of the low-level terraces and stream beds are outwash material thought to have been deposited in Wisconsinan glacial time on bedrock valley bottoms that were on the order of 100 feet lower than present ones. The present streams, in other words, are flowing on alluvial deposits that accumulated to this depth as an abundance of glacial rock debris was being transported downstream away from glacial sources to the north. A common thickness of these glacial deposits is in the 50- to 85-foot range. Similar thickness is reported for the high-level terrace deposits. The quality of the sand and gravel in the low-level terraces and stream beds is better than that in the high-level deposits because the lower level (and younger) deposits are less weathered.

Another source of sand and gravel are the kames, kame terraces, kame moraines, and eskers distributed throughout several counties in the area once covered by glaciers. This area includes all of Mercer County, most of Lawrence County, and parts of Beaver, Butler, and Venango Counties. The distribution of these deposits is shown on the Glacial Deposits Map of Northwestern Pennsylvania by Shepps (Bulletin G32, Pa. Geol. Survey, in Appendix VI). Most of the places where the glacial deposits are being worked are in Lawrence and Mercer Counties, but several are in Butler and Venango Counties as well.

Ground water in the Pennsylvania ORBES Region occurs in both bedrock formations and in unconsolidated Pleistocene glacial deposits. The latter deposits occur not only within the glaciated area itself but also outside it in the form of outwash deposits along the Allegheny, Beaver, and Ohio River valleys. A generalized map of the Pa. Geological Survey (Fig. 2.1.1.-14) shows the water-yielding capabilities of bedrock formations in the region, but does not evaluate the surficial deposits within the glaciated area. The map indicates that throughout the largest part of the region there are bedrock aquifers capable of yielding 100 to 200 gallons per minute from wells. Lower yields, on the order of 25 to 50 gallons per minute, are common in two counties (Washington and Greene) in the southwestern corner of the state. Bedrock aquifers with the highest yields (200 to 850 gpm) are available in the northern tier of counties of the region (Mercer, Venango, Forest, Elk particularly) and in the Laurel Hill, Chestnut Ridge, Negro Mountain areas of Fayette, Westmoreland, and Somerset Counties. The highest water yields of all come from the permeable, unconsolidated glacial sands and gravels. Yields up to 2,000 gpm are reported from these.

Within the glaciated area (see Fig. 2.1.1.-14) and Glacial Deposits Map of General Geology Report G32 in Appendix VI) the thickness of glacial deposits ranges from a few feet to as much as 400 feet. The deposits are thickest where deep bedrock valleys have been filled, or partly filled, with glacial drift. Some of the drift is relatively impermeable till and some is very permeable sand and gravel. It is the sand and gravel beds that are the good aquifers. For the most part, sand and gravel deposits occur along valleys whose dominant orientation is northwest-southeast. The glacial map shows these deposits collectively as kames, kame moraines, kame terraces, and eskers of either Wisconsinan or Illinoisan age.

There are also outwash deposits that have been transported beyond the glacial boundary and deposited on the bedrock floor of the Allegheny, Ohio, and Beaver valleys. As explained in the section dealing with Sand and Gravel Resources, this type of deposition occurred at two different stages, first in Illinoisan glacial time and later in Wisconsinan glacial time so that these outwash deposits are now found at two different levels. The earlier deposits (Illinoisan) occur about 200 feet above the present streams and are known as the "high-level" terraces; the lower ones occur in the bottom of the present valleys and are known as the "low-level" terraces. The thickness of these deposits at both levels is on the order of 50 to 85 feet. The present streams are flowing on these deposits and not on a bedrock floor. Industrial plants along the Allegheny and Ohio valleys obtain ground water from wells drilled into the valley-bottom deposits. Some communities also obtain part of their water supply from that source. In the Pittsburgh area, this flow of ground water through the Wisconsinan outwash sand and gravel is popularly known as Pittsburgh's "underground river."

Bedrock aquifers are primarily sandstones in the 20- to 40-foot thickness range although locally they may be as thick as 80 to 100 feet, or even as much as 300 feet in the case of the Pocono Formation. The better aquifers occur in the upper part of the Mississippian System and in the Pottsville Group of the Pennsylvanian System. These aquifers include the Pocono sandstone (Mississippian) and the Connoquesnessing and Homewood sandstones of the Pottsville Group. There are also good aquifers in the Allegheny Group, particularly in the lower part. Areas in which a given aquifer is productive depend in part on its position with respect to depth below the surface. The optimum position is one below drainage level, that is, below the level of the deepest valley in the area but above the zone of brackish water and salt water. Another factor that governs the quality of an aquifer is its permeability. Sandstones in the Pennsylvanian System typically show lateral variations in permeability so that a given sandstone aquifer may yield quite different amounts of water from place to place.

A generalized evaluation of bedrock aquifers in the ORBES Region is as follows:

Bedrock Unit	Yield from Wells (gpm)		Counties where Aquifer Occurs
	Median	Range	
Dunkard Group			
Greene Formation	2	1 to 35	Washington and Greene
Washington and Waynesburg Formations	2	1 to 70	" "
Monongahela Group	1	1 to 50	Washington, Greene; parts of Allegheny, Fayette, Westmoreland
Conemaugh Group	10	2 to 200	Allegheny, Beaver, Butler, Armstrong, Westmoreland, Fayette, Jefferson, Indiana, Somerset, Clearfield, and Cambria
Allegheny Group	35	5 to 500	Beaver, Lawrence, Mercer, Butler, Clarion, Armstrong, Jefferson, Indiana, Somerset, Clearfield, and Cambria
Pottsville Group	35	5 to 500	Lawrence, Mercer, Venango, Forest, Clarion, Elk, Jefferson, Clearfield, Somerset, Fayette, and Westmoreland
Mississippian System Pocono Formation	?	? to 1,000	Mercer, Venango, Forest, Elk, Somerset, Fayette, and Westmoreland

(see Figure 2.1.1.-6 for stratigraphic positions)

It is noted that, in general, the better bedrock aquifers occur lower in the stratigraphic section and that they are present in the northern counties of the region at suitable depths for them to be good aquifers. It is the south-southwesterly dip of strata in the region that causes these more permeable formations to be too deep (in the salt-water zone) in the southern counties but at shallower depths and within the fresh-water zone in the northern counties. An exception is in the southeastern counties of Fayette, Somerset, and Westmoreland where anticlinal folds cause the aquifers to be shallow enough to be in the fresh-water zone.

The evaluation of bedrock aquifers on a stratigraphic basis as presented above can be related to water-yielding capabilities by area as Figure 2.1.1.-14 shows. Relatively low yields of 26 to 50 gallons per minute in areas depicted in purple color are found where aquifers occur principally in the

Dunkard and Monongahela Groups. Higher yields of 101 to 200 gpm in the widespread area of orange-red coloration occur mainly in Conemaugh Group aquifers, and the highest yields from bedrock aquifers of 201 to 859 gpm in the green areas are present where Pocono, Pottsville, and Allegheny aquifers occur. Water yielding capacity data in Figure 2.1.1.-14 and those in the above evaluation do not match because Figure 2.1.1.-14 shows the median-yield range of that formation within an area having highest yield whereas the above figures are those for all aquifers within the various stratigraphic units represented. It should also be pointed out that Figure 2.1.1.-14 does not show areas where the highest water yields of all occur (2,000 gpm or more), namely those where permeable, stratified glacial deposits are present.

Further information on ground water may be found in publications by Poth (1973, 1974), Newport (1973), Gallaher (1973), Schiner and Kimmel (1976), Carswell and Bennett (1963), Lohman (1938, 1939), Leggette (1936), and Piper (1933).

F. Seismicity

Seismic activity in eastern United States has been studied recently by the U.S. Geological Survey in cooperation with the U.S. Atomic Energy Commission. One result of the study is a seismotectonic map showing major tectonic features, the location of epicenters of earthquakes having an intensity of III or higher on the Modified Mercalli scale, and areas of seismic activity classified according to seismic activity level and structural control (Hadley and Devine, 1974). Figure 2.1.1.-15 is a portion of the tectonic map published in that study. It shows that western Pennsylvania lies within two tectonic provinces, the western part of the Central Appalachian Fold Belt and eastern part of the Findlay Arch which is the northeast branch of the Cincinnati Arch. There are no major faults shown in the ORBES Region of Pennsylvania, although faults of less than major extent do occur in the southeastern part where the most pronounced folds are located (Chestnut Ridge anticline, Laurel Hill anticline, and Negro Mountain anticline), and in the northeast (Clearfield County) where folding is less pronounced but minor faults are common. In the central and western part of the region faults are virtually unknown and folds are very gentle, particularly in the west where folds die out and a gentle, fairly uniform southeasterly dip away from the crest of the Findlay Arch prevails.

Figure 2.1.1.-16, also from the Hadley and Devine report, shows that two epicenters of earthquakes of MMIII or higher occurred in the Pennsylvania ORBES Region in the period from 1800 to 1972. Those earthquakes were minor ones in the MMIII to VI range. An earthquake of intensity III is so mild that many people do not recognize it whereas one of intensity VI is felt by all yet damage is slight, meaning that damage is restricted to such things as fallen plaster and broken chimneys. Figure 2.1.1.-16 has seismic frequency contours plotted on the basis of the total number of earthquakes of intensity greater than MMIII per 10,000 square kilometers. The contours are numbered 4, 8, 16, and 32, thus some areas are ones of low seismicity in which there have been between 0 and 4 earthquakes per $10^4 km^2$. Other areas have a frequency between 4 and 16, and between 16 and 32. The ORBES Region of Pennsylvania falls entirely within the 0 to 4 frequency category. Data on which

Figure 2.1.1.-16 is based were obtained from the Environmental Data Service of the National Oceanic and Atmospheric Administration, and from the Dominion Observatory, Ottawa, Canada.

Another result of the U.S. Geological Survey study was the delineation of seismic-activity areas. These areas were determined on the basis of (1) seismic frequency or areal density of epicenters, (2) maximum epicentral intensity, and (3) structural control of epicenter distribution. Five levels of seismic activity and three categories of structural control were used. The ORBES Region is categorized by activity level 1, the lowest level of seismic activity. At that level structural control is not relevant, meaning that there are no geologic structures (faults) with which seismic activity might be associated. The closest areas where more intensive activity is indicated are in northeast and southeast Ohio where areas of activity level 2 are present, meaning that earthquake frequency is in the 8 to 32 per 10^4km^2 range, but no earthquake of maximum epicentral intensity greater than VI has occurred. The closest area to the east where areas of seismic activity levels 2 and 3 occur is in southeastern Pennsylvania, western Maryland, and the eastern West Virginia panhandle. At level 3, earthquake frequency is from 8 to 32 per 10^4km^2 and at least one earthquake of epicentral intensity VII or VIII is recorded. An earthquake of intensity VII does considerable damage to poorly built or badly designed structures, and one of intensity VIII does great damage to poorly built structures and considerable damage to ordinary substantial buildings.

A geologic explanation of these two more seismic areas to the west and east that border the area of low seismicity in western Pennsylvania is given by King and Zietz (1978). They have identified a major northeast-trending lineament in the basement rocks under the Appalachian basin extending from New York to Alabama (Fig. 2.1.1.-17). This lineament was identified by aeromagnetic mapping principally, with additional data from regional gravity surveys. King and Zietz think that the lineament marks the southeast edge of a stable crustal block. The northwest edge of that stable block is marked by a parallel, seismically active zone extending from New Madrid, Missouri to the St. Lawrence River valley. The ORBES Region of Pennsylvania lies within the stable block, and the two seismic areas to the southeast and west lie within less stable zones that are probably related to deep-seated, geologically old strike-slip fault zones in the basement rocks. The only two areas of level 5 seismic activity in eastern United States include the New Madrid site in Missouri and the Charleston area in South Carolina. Those are areas that have experienced earthquakes of intensity IX or higher (great damage, buildings shifted off foundations) and in which seismic frequency is greater than 64. The Attica area of western New York (Fig. 2.1.1.-15) is one of seismic activity level 3 (earthquake frequency between 16 and 32 and at least one earthquake of intensity VII or VIII). Attica is considered part of the seismic belt that extends from New Madrid, Missouri to the St. Lawrence River valley.

There are 5 stations that monitor seismic activity in Pennsylvania, all operated by the Pennsylvania State University (Fig. 2.1.1.-18). Two are in western Pennsylvania at Erie and Beaver. The other three are at State College, Millersville, and Abington (near Philadelphia). These are part of a network of seismic stations that form the Northeastern U.S. Seismic Network. Quarterly bulletins of seismicity of northeastern United States have been issued since March, 1976. No Pennsylvania ORBES Region earthquakes are reported in these bulletins for the period from October, 1975 through December, 1977.

2.1.2. CLIMATOLOGY

2.1.2.1. CLIMATOLOGIC CHARACTERISTICS

A. General

The ORBES Region of Pennsylvania has a humid, continental-type climate. Prevailing westerly winds bring most of the weather disturbances from the interior of the continent, but coastal storms occasionally affect the weather of the region. The topography of the Allegheny Plateau locally influences the weather. Rugged terrain causes considerable variation in the freeze-free season, it being considerably shorter in northern counties than in southern counties. Latitudinal difference between the northern and southern sections has a climatic effect.

The climate of Pennsylvania is summarized in a publication by Daily (1971). Local climatological data are available from the Environmental Science Services Administration - Environmental Data Service at Asheville, North Carolina and from the National Oceanic and Atmospheric Administration Climatologist at the Pennsylvania State University.

B. Precipitation

Mean annual precipitation in the Pennsylvania ORBES Region is about 41 inches; the range is from 35 inches to 47 inches (see map, Fig. 2.1.2.-1). The greatest amount of precipitation occurs in the southeastern mountainous section in Somerset, Cambria, Westmoreland, and Indiana Counties; the least amount occurs in the central-west part, in the Ohio Valley area of Beaver County. Precipitation data for the 1941-1970 period from 36 weather stations throughout the region are presented in Tables 2.1.2.-1 and 2. At Pittsburgh, in the period from 1872 through 1976, the mean annual precipitation was 36.15 inches. At the same locality the mean annual precipitation ranged from a high of 43.38 inches (in 1950) to a low of 26.79 inches (in 1963) in the 40-year period from 1937 through 1976 (Figure 2.1.2.-3). Precipitation is fairly well distributed through the year, although larger amounts usually fall in the spring and summer than in other seasons. July is generally the wettest month and February the driest. Winter precipitation is ordinarily 3 to 4 inches less than that in summer. Mean monthly precipitation at Pittsburgh between 1872 and 1976 was at a maximum of 4 inches in July and minimum of 2.36 inches in November (Fig. 2.1.2.-2). At Ebensburg in Cambria County precipitation was 11.6 inches in June, 1972, the month in which Hurricane Agnes occurred.

Rainfall amounts of both one-hour duration and 24-hour duration that can be anticipated in a 2.33-year return period have been estimated (Pennsylvania Department of Environmental Resources, COWAMP report Study Areas 8 and 9, 1975). Figures 2.1.2.-4 and 5 show by means of rainfall lines (isopluvial lines) the expected amounts in the ORBES Region. On the basis of these maps the greatest rainfall of one-hour duration (between 1.4 and 1.5 inches) is likely to occur in Indiana and Armstrong Counties. Greatest rainfall of 24-hour duration in a 2.33-year return period is likely to occur in the southeastern section in Somerset, Fayette, Westmoreland, Cambria, Indiana, and Armstrong Counties where values range from 2.4 to more than 2.8 inches. Within these southeastern counties the greatest local concentration is indicated in southern Somerset County where the highest terrain of the region occurs. Maximum amounts of precipitation at various intervals (1, 2, 3, 12, and 24 hours) recorded at 23 different stations in the region are presented in Table 2.1.2.-3.

Occasional dry spells may persist for several months in the region. They are not confined to any particular season. During these spells monthly precipitation may be less than one-quarter inch.

Prior to industrialization, the pH of rainfall was governed primarily by the carbon dioxide content of the atmosphere (300 ppm). Based upon this concentration and the equilibrium of carbon dioxide dissolved in water, a pH of 5.7 can be "back-calculated" as the pH value of rain unaffected by man's activity. Acid rainfall is currently a "hot issue" in the Northeastern United States. Emissions of sulfur dioxide to the atmosphere are believed to be the reason for pH measurements less than 5.7. Kane (1974) measured a pH range of 4.1 to 5.8 on precipitation events seven miles north of downtown Pittsburgh. He reported, from a comparison of free H^+ content with total H^+ content, that Pittsburgh precipitation is a weak acid solution. Kane's calculated pK values, ranging from 4.39 to 7.58 with an average of 5.56, further support this conclusion. Gelburd (1977) measured the pH spectrum of individual raindrops from six precipitation events in Pittsburgh. He detected a pH range of 3.9 to 5.0 among the individual drops of all six events. The "drop average" for each of the six events was found to range from 4.3 to 4.7.

C. Temperature

The average annual temperature in Pennsylvania ranges from about 47° in the north-central Plateau to 57° in the southeastern part of the State. Although precise data for the ORBES Region are not available, the average annual temperature within it is probably about 50°. The average summer temperature in the region is near 70°; the average winter temperature about 30°. Figure 2.1.2.-19 shows for Pittsburgh the average monthly temperature, and also the average daily maximum and minimum temperature on a monthly basis. Temperatures above 90° occur on the average of 10 to 20 days per year in the region. Northern counties have fewer days with such temperatures than southern counties. Freezing temperatures occur on the average of about 100 days. Below 0° readings have been recorded from November through April. January mean minimum temperatures range from 15° to 25°; January mean maximum temperatures are in the 35° to 43° range. In July mean minimum temperatures are in the 52° to 65° range and mean maximums in the 80° to 87° range. The distribution of July and January mean maximum and minimum temperatures throughout the region is shown in Figures 2.1.2.-6, 7, 8, and 9. These isothermal maps show that the coldest areas are in the northeast (Elk, Forest, and Venango Counties) and the warmest areas are in the southwest (Greene, Washington, Allegheny, Beaver, Butler, and Lawrence Counties).

At Pittsburgh, in the period 1969-1976, the total heating degree days (based on a temperature of 65°) ranged from a high of 6,336 to a low of 5,282. The total cooling degree days in that same period ranged from 855 to 358.

D. Thunderstorms and Tornadoes

Thunderstorms average between 30 and 55 per year. They occur mostly in the summertime and account for most of the summer rainfall. At Pittsburgh there was a yearly average of 37 thunderstorms in the decade from 1968 to 1977 (Figure 2.1.2.-18). The greatest number in this period was 43 in 1974; the least number was 28 in 1969.

Although hurricanes rarely affect the area, tornadoes do occasionally occur. An average of 5 to 6 tornadoes are recorded annually in Pennsylvania. June is the month of highest frequency followed closely by July and August. The southwest plateau area is one of the three principal ones for such storms. The other two areas are the extreme northwest and the southeastern Piedmont. The most destructive tornado activity in the State occurred in the ORBES Region in southwestern Pennsylvania on June 23, 1944. On that date, there were three tornadoes that killed 45 persons, injured 362, and caused more than $2 million property damage. Figure 2.1.2.-20 is a map showing areas in eastern and southern United States affected by tropical storms that caused destruction between 1901 and 1955. It is noted that there is a northeasterly trending belt of such storms through West Virginia, Pennsylvania, and New York, and also a western "bulge" extending across Lake Erie and adjacent parts of northern Ohio, southeastern Michigan, and Ontario, Canada.

E. Flooding

Floods may occur in any month. They occur most frequently in March and April, but heavy rains may produce a flood in any season. In winter, heavy rains combined with snowmelt may cause flooding. Local flooding sometimes results from ice jams during a spring thaw, particularly along the Allegheny River. Localized thundershowers may also cause severe flash-flooding. Floods are expected at least once in most years. At Pittsburgh, flood stage is expected on the average of 1.3 times per year, based on the long-term record. Years in which major flooding occurred on the Allegheny River are 1865, 1889, 1892, 1905, 1907, 1910, 1913, 1936, 1942, 1947, and 1964; on the Monongahela River in 1888, 1907, 1918, and 1936; and on the Ohio River in 1907, 1936, 1942, and 1954 (Dailey, 1971). Hurricane Agnes which caused major flooding in eastern Pennsylvania in 1972 did not so affect the ORBES Region in the western part of the State. Construction of several flood-control dams in the Allegheny River and Monongahela River systems in the last two or three decades has alleviated damaging floods considerably although the threat still exists as evidenced by the Johnstown flood of 1977.

F. Snow

Winter storms most commonly move northeasterly through the area. When temperatures are low enough snowstorms of considerable magnitude may occur. Some storms drop as much as 30 inches of snow as did the November, 1950 storm at Pittsburgh. Annual snowfall has a wide range from one locality to another and from one year to another. Mountainous areas in the northern part of the region may receive more than 100 inches in a year whereas lower-lying and more southerly areas may receive less than 10 inches. A map of the average annual snowfall in the region is presented in Figure 2.1.2.-10. At Pittsburgh the mean annual snowfall in the 24-year period from 1953 to 1976 was 45.3 inches; the range was from a low of 16.6 inches in 1974-75 to a high of 82 inches in 1950 in the period between 1937-38 and 1975-76 (Figure 2.1.2.-12).

Measurable snow generally falls between November 20 and March 15 in the region, but snow has been recorded as early as the beginning of October and as late as May. The largest monthly amount usually occurs in December and January, but at Pittsburgh it occurred in January and February in the 1953 to 1956 time period (Figure 2.1.2.-13). The greatest amount of snow from a single storm usually comes in the month of March.

G. Growing Season (freeze-free season)

Altitude is an important control of the growing season. At the higher altitudes the growing season is shortened because of a greater potential for frost in the early fall and late spring. The growing season in the region ranges from a low of about 115 days in Elk County in the northeastern part to a high between 175 and 180 days in parts of Allegheny County in the southwestern part (Figure 2.1.2.-11). The southernmost parts of the region do not have the longest growing season nor does the most northerly part in general have the shortest growing season. This is because of the hilly terrain in the south where nocturnal cooling is effective in valleys, and the ameliorating influence of Lake Erie in the north, especially in the northwestern counties closest to the lake (Mercer and Venango). The average length of the growing season in various parts of the region as depicted by the "iso" lines in Figure 2.1.2.-11 can be misleading. At specific locations there may be considerable departure from the average. For example, at Somerset (Somerset County), in a 33-year period the growing season averaged 134 days, but the range was from 86 to 171 days.

H. Wind

Prevailing winds in the region are from the west-southwest. As cyclonic storms move through the area wind directions may change through the 360 degrees of a circle, but the direction of the wind that blows the greatest percentage of the time is west-southwest, i.e., it is the prevailing wind. Monthly wind data from the weather station at Greater Pittsburgh airport for the 10-year period 1968-1977 are plotted in Figures 2.1.2.-14, 15, and 16. In figure 2.1.2.-16 resultant wind direction for each month in that period is shown by means of directional arrows. Resultant wind is the vector sum of wind directions divided by the number of observations. There was a 35-degree variation in the direction of resultant monthly winds in the 10-year period, from 280 degrees (west-northwest) to 245 degrees (west-southwest). The prevailing direction, or the average of the resultant monthly winds, was 260 degrees (west-southwest). The more northerly resultant winds (276 and 280 degrees) occurred in February and May and the more southerly ones (245 to 266 degrees) occurred in the remaining months of the year.

The maximum wind speed at Pittsburgh since 1953 was 58 miles per hour in February, 1967. That, too, was a west-southwest wind (260 degrees). Maximum wind speeds represent the fastest one-minute value observed.

I. Fog

Heavy fog is defined as fog that reduces the visibility to one-quarter mile or less. The ORBES Region is subject to such fog. Cold air drainage down the slopes into valleys frequently leads to the forming of early morning fog; particularly during the cooler months.

Fog data from Pittsburgh (Greater Pittsburgh airport) are plotted for the period 1968-1977 in Figure 2.1.2.-18. The number of days of heavy fog ranged from a low of 9 to a high of 28. The average number of days per year of heavy fog in that 10-year period was between 20 and 21.

J. Clear Days

A clear day is one during which the sky cover is between 0 and 3 on a scale of 10. At a value of zero there are no clouds at all and at 10 the sky is completely overcast. At Pittsburgh in the 1968-1977 decade the number of clear days ranged from a mimimum of 47 to a maximum of 75. The average number of clear days was between 59 and 60 (Figure 2.1.2.-17).

2.1.2.2. AIR POLLUTION POTENTIAL

A. Basic Meteorology

Holzworth (1972) has made a study of the potential for air pollution in the United States, and has produced a map showing the total number of forecast-days of high meteorological potential for such in a 5-year period (Figure 2.1.2.-21). This map shows that in the ORBES Region of Western Pennsylvania the number of forecast-days is in the 15- to 25-day range.

B. Teknekron Data

Nieman and Mahan (1978) examined the impact of long-range transport of air pollutants from Ohio and West Virginia upon Pennsylvania's air quality. It was determined, by examination of meteorological data, that the first and second most frequently occurring persistent winds were directed toward Western Pennsylvania from Ohio and West Virginia. On the average, these wind conditions occur at most locations approximately thirty times or more per year. Analysis of June 1974 - August 1977 air quality data revealed that the 24-hr. TSP (total suspended particulates) standard was violated 33 times at the Sharon-Farrell Site (Mercer County) while the 24-hour sulfate standard was violated 7 times at the same location. Long-range transport conditions "...were either confirmed or deemed probable for 63% of the days on which either of these standards was exceeded. Long-range transport from the southwest and the south predominated, although dates were also found with transport from the north-northwest, the west, and the south-southwest." Analysis of air quality data from Monongahela Valley monitors #3 (Washington County) and #5 (Fayette County) revealed long-range transport conditions on 38% of the days when the secondary 24-hr. TSP standard was exceeded and 33% of the days on which the sulfate standard was exceeded. On the dates of standard-excursions 46% of the extremely persistent winds came from the southwest, 39% from the west, and 15% from the south.

2.1.3. SOILS

2.1.3.1. SOIL TYPES AND DISTRIBUTION

A. General

Soils are important from the standpoint of agriculture, vegetation, soaking up of rainfall and snowmelt, disposal of domestic wastewater by means of septic tanks and seepage beds, slope stability, and for the disposal of industrial and municipal wastewater by spray irrigation and ridge-and-furrow spreading.

Soil is composed principally of weathered rock material, organic matter, and water. It is derived from the physical and chemical alteration of parent bedrock, alluvium, and glacial deposits. Soil characteristics are determined by such factors as the nature of the parent material, topography, climate, plants and animals living on or in it, and time. Thin soil generally develops on steep slopes and thick soil on gentle or flat slopes including flood plains and flattish upland areas. Colluvial soil is that which has moved downslope to an "out-of-place" position.

B. Classification

Soils vary in color, texture, structure, and degree of compaction. Color is affected by the parent material, leaching and oxidation of minerals in the soil, organic matter, and vegetation types. Texture refers to the size, shape, and abundance of constituent particles. A textural classification delineates such types as sand, loam, and clay, and various combinations of those. Texture is an important property as it affects the permeability of soil. Soil structure refers to the manner in which discrete particles are arranged and held together as an aggregate. Different soil structures are described as crumb, granular, blocky, columnar, and platy.

Soils are generally classified in "soil series" according to their properties. They are placed in various series on the basis of profile characteristics determined from cores. Names applied to soil series are names of towns or physiographic features (such as the Monongahela Valley terraces).

Soil series are generally mapped at a scale of 1:20,000 or larger. Smaller scale regional mapping is done to show the distribution of "soil associations" which are groupings of soil series. The General Soil Map (Figure 2.1.3.-1) is a soil associations map of the region. It is adapted from an "Environmental Resources Inventory of the Pittsburgh District" of the U.S. Army Corps of Engineers. It is useful in making general comparisons of soils in the study area but not for planning specific land uses. Soil interpretations for wastewater disposal suitability are based almost entirely on the soil series category. Soil associations ordinarily contain one or more major soil series and at least one minor soil series. Soil series in a given soil association may also occur in another association, but commonly in a different pattern, that is, with different proportions of the series that compose the association.

C. Mapping

The accompanying General Soil Map (Figure 2.1.3.-1) produced by the U.S. Army Corps of Engineers (1976), shows soil associations that occur in a consistent, defined geographic pattern. Each association normally consists of a few major soils and several others that are less extensive. The name of an association is derived from the soil of greatest areal extent. As may be noted, major soils in one association may occur in one or several other associations.

Soils within one association are closely related geographically but may differ widely in their properties such as slope, depth, texture, or natural drainage. Because of such differences, the soils within the association may vary in their suitability for agriculture and/or non-agricultural use. A general soil map such as this is adequate only for the purpose of getting a broad, overall picture of relative conditions across a county or region but not for specific selection of sites or for design purposes.

The best and most recent state and regional soil maps were utilized in compiling the General Soil Map. The table, Soil Properties and Limitations Affecting Selected Land Uses (Table 2.1.3.-1) lists and describes major soils in each association. For the soils of the region, it summarizes their natural drainage and physiographic position, their texture and soil profile, slope range, depth to rock, and seasonal high-water table, permeability, engineering classification, and use limitations. The major soil limitations for most engineering and agricultural uses in the project area are steep slopes and seasonal wetness. The wetness problem is most often caused by fragipan which is a dense, firm layer at varied depths that in effect causes a high-water table, normally during the spring months. Shallow soils generally are associated with steep slopes. These two factors, steep slopes with their associated thin soils and seasonal wetness, combine to impose severe restrictions on most uses other than those associated with forestry recreation and wildlife.

Soil association maps are available for 12 of the 19 counties in the ORBES Region (Allegheny, Armstrong, Beaver, Butler, Clarion, Clearfield, Indiana, Jefferson, Lawrence, Mercer, Venango, and Westmoreland). Some maps are in color, some in black and white. Most of them are at a scale of about 4 miles to an inch. Others are at 3, approximately 5, and approximately 8 miles to an inch. Accompanying each map is a brief description of soil associations in the county. The available county soil maps and descriptions of soil associations are included in Appendix VII.

2.1.3.2 SOIL SUITABILITY FOR WASTE DISPOSAL

A. Methods

A Comprehensive Water Quality Management Plan (COWAMP) study of the Upper Allegheny River basin (Study Area 8) has been undertaken by the Pennsylvania Department of Environmental Resources. The following information on methods of disposal of wastewater, and on the evaluation of soil for wastewater disposal is from a preliminary draft copy of a 1975 report of that study.

The "no-discharge" policy of the Federal Water Pollution Control Act Amendments of 1972 has resulted in a great deal of recent interest in land disposal of wastewater and treatment process residues which may contain viruses, bacteria, antibiotics, hormones, nutrients, herbicides, fungicides, pesticides, heavy metals and toxic chemical compounds. Successful land disposal is dependent on the ability of the soil to remove these substances without contamination of ground and surface water.

Land disposal of wastes has been practiced for centuries through use of privies, cesspools and septic tanks. Basic elements of a standard septic tank - seepage bed system are depicted in Figure 2.1.3.-2. Waste effluent from the home enters the septic tank, a watertight steel or concrete container which removes solids from wastewater so that effluent from the tank will be transmitted more easily through soil. Suspended particulate matter in the sewage settles and accumulates as sludge in the bottom of the tank. Anaerobic biological decomposition of organic matter in the sludge reduces its volume and releases methane, carbon dioxide, ammonia and soluble organic compounds. A scum of solids also forms at the water surface; both sludge and scum accumulations should be removed from the tank periodically to prevent overflow into the disposal field. Effluent from the tank is disposed of in a seepage bed consisting of one or more trenches partially filled with gravel. Drain pipes are placed on top of gravel along the length of each trench, then earth is filled into the surface. Drain pipes allow effluent to flow into the gravel trenches where it discharges evenly into the soil.

Where physical conditions (i.e. slope, soil, etc.) are not conducive to a standard septic system, the Department of Environmental Resources will permit use of alternative methods such as an elevated sand mound, a sand-lined trench, an oversize area, or a method devised for shallow placement areas. These alternative methods must be designed by a registered professional engineer, and must be used with extreme caution.

Spray irrigation, a relatively new method of disposing of municipal sewage effluent in the United States, has been used in Europe for centuries; however, spray irrigation, (or a modification, ridge-and-furrow spreading) has a respectable history of use in the United States by the food processing industry for disposal of seasonal wastes.

In any system for renovating wastewater through spray irrigation, sewage generally is pretreated to remove suspended solids. The effluent is then pumped by pipeline to forested and agricultural areas where it is sprinkled onto land surface. In the forest, nutrients (predominantly nitrogen and phosphorus) from the wastewater are cycled and recycled through trees, leaves, other vegetation, and the forest floor. Nutrients from water sprayed on agricultural areas are taken up by plants which eventually are harvested. As remaining wastewater seeps through soil into the groundwater reservoir, a certain amount of renovation takes place, thus, plants and soil act as a natural filter for the effluent. If the system is properly designed and operated, high-quality water is recharged to the groundwater reservoir. This renovated water can then be drawn up through wells to supplement natural groundwater supply, or eventually be discharged to rivers and lakes.

Sludge is the solid phase by-product of physical, chemical or biological treatment of wastewater. As it comes from the treatment-plant processing stream, solids content is low (less than 5%), so sludge usually is dewatered to increase the solids content and reduce cost of ultimate disposal. Treated sludge may be landfilled, incinerated, or spread onto the land surface. Untreated sludge (under strict control) may be sprayed directly onto land surface in agricultural or forested areas similar to the spray irrigation of effluent.

The major residues of coal-fired power plants include: (a) fly ash, (b) bottom ash (defined as bottom ash and boiler slag), and (c) flue gas desulfurization (FGD) sludge resulting from the removal of sulfur dioxide from the combustion gases. In the Pennsylvania ORBES Region most coal ash disposal sites are located in ravines or basins with deposition depths ranging from 200 to 300 feet. The land consumed for disposal ranges from 240 acres (for a 1,000 MW plant with 10-yr. life, operating @ 70% l.f.) to 1,000 acres (for a similar plant with a 30-yr. life) (Bern, 1976). Perhaps the most outstanding disposal location within the study area is the Little Blue Run Valley site in Beaver County. This 8.2 million cubic yard, man-made impoundment accommodates the wastes of the Bruce Mansfield plant and was named one of ten outstanding engineering achievements of 1976 by the National Society of Professional Engineers. This site and other industrial waste disposal sites of the Pennsylvania ORBES Region are listed in Table 2.1.3.-2.

B. Site Suitability

Land disposal of municipal wastes is permitted through the Pennsylvania Department of Environmental Resources which sets standards for all sewage disposal facilities in the Commonwealth. Table 2.1.3.-3 summarizes important criteria and standards for land disposal of wastes as established by DER.

It has been determined in the COWAMP study that in 16 counties of the Pennsylvania ORBES Region a small percentage of the land is suitable for spray irrigation and sludge disposal (Table 2.1.3.-3). This is probably also true of the other three counties (Clearfield, Cambria, Somerset) for which such data are not yet available. Because of the low percentage of area suitable for conventional septic systems alone, areas suitable for septic tanks includes both alternate and standard systems (Table 2.1.3.-4). Areas suitable for only standard septic tank disposal systems closely coincide with those suitable for spray irrigation and sludge disposal.

The generally negative results of soil-suitability evaluation in the study area point out the need for thorough site evaluation before designing a land disposal system. In addition, if large-scale spray irrigation of treated effluent is considered as an alternative to other methods of wastewater treatment and disposal, a close look at current standards, controls, and criteria may be required.

Coal ash and FGD sludge disposal sites should include a stable foundation, control programs for groundwater and surface water contamination, and slope stabilization by revegetation. Fly ash and bottom ash sites may cover a wide variety of topographic situations. In some instances the residues may be pumped to the final disposal site without further processing. In ravine or slope site disposal the material must be handled as required to maintain the structural integrity of the area. In some ravine operations, fly ash and bottom ash are mixed to optimize the shear strength characteristics of the fill. Moisture content of this material is carefully controlled and vibratory compactors may be employed. Several proposed sites are considering mixing dry fly ash with FGD sludge in ratios needed to lower the resultant moisture content for the maintenance of structural stability.

TABLE 2.1.1.-1

Recoverable coal reserves of Pennsylvania over 24, 28, and 36 inches thick by counties and rank as of January 1, 1970 (millions of short tons).

	Recoverable reserves over 24 inches thick						Recoverable reserves over 28 inches thick						Recoverable reserves over 36 inches thick					
FIELD COUNTY[1]	Total > 24"	High-vol. bituminous	Med.-vol. bituminous	Low-vol. bituminous	Semi-anthracite	Anthracite	Total > 28"	High-vol. bituminous	Med.-vol. bituminous	Low-vol. bituminous	Semi-anthracite	Anthracite	Total > 36	High-vol. bituminous	Med.-vol. bituminous	Low-vol. bituminous	Semi-anthracite	Anthracite
MAIN BITUMINOUS AND GEORGES CREEK FIELDS																		
Allegheny	850	850	–	–	–	–	680	680	–	–	–	–	260	260	–	–	–	–
Armstrong	1,200	1,200	–	–	–	–	1,100	1,100	–	–	–	–	830	830	–	–	–	–
Beaver	680	680	–	–	–	–	350	350	–	–	–	–	200	200	–	–	–	–
Blair	11	–	8	3	–	–	9	–	7	2	–	–	3	–	2	1	–	–
Butler	1,100	1,100	–	–	–	–	860	860	–	–	–	–	370	370	–	–	–	–
Cambria	1,400	–	560	840	–	–	1,000	–	400	600	–	–	390	–	160	230	–	–
Cameron	18	12	6	–	–	–	13	9	4	–	–	–	0	0	0	–	–	–
Centre	120	–	120	–	–	–	83	–	83	–	–	–	3	–	3	–	–	–
Clarion	630	630	–	–	–	–	450	450	–	–	–	–	80	80	–	–	–	–
Clearfield	1,000	250	750	–	–	–	710	180	530	–	–	–	90	22	68	–	–	–
Clinton	15	–	15	–	–	–	9	–	9	–	–	–	6	–	6	–	–	–
Elk	140	140	–	–	–	–	110	110	–	–	–	–	46	46	–	–	–	–
Fayette	2,500	2,000	500	–	–	–	2,100	1,700	400	–	–	–	1,100	830	270	–	–	–
Greene	4,500	4,500	–	–	–	–	4,000	4,000	–	–	–	–	2,700	2,700	–	–	–	–
Indiana	2,100	1,600	500	–	–	–	1,700	1,300	400	–	–	–	630	470	160	–	–	–
Jefferson	1,100	1,100	–	–	–	–	880	880	–	–	–	–	260	260	–	–	–	–
Lawrence	160	160	–	–	–	–	150	150	–	–	–	–	77	77	–	–	–	–
McKean	130	130	–	–	–	–	96	96	–	–	–	–	5	5	–	–	–	–
Mercer	110	110	–	–	–	–	82	82	–	–	–	–	21	21	–	–	–	–
Somerset	2,000	–	1,000	1,000	–	–	1,600	–	800	800	–	–	670	–	340	330	–	–
Venango	120	120	–	–	–	–	81	81	–	–	–	–	7	7	–	–	–	–
Washington	4,300	4,300	–	–	–	–	3,800	3,800	–	–	–	–	2,600	2,600	–	–	–	–
Westmoreland	2,200	1,700	500	–	–	–	1,900	1,500	400	–	–	–	1,300	1,000	260	–	–	–
Field Totals	27,000	21,000	4,000	1,800	–	–	22,000	17,000	3,000	1,400	–	–	12,000	9,800	1,300	560	–	–

From Edmunds, 1972

TABLE 2.1.1.-2

In-place Coal Reserves of Pennsylvania by Counties as of January 1, 1970 (Millions of short tons)

Field County	Minimum thickness included	Mined out and lost to 1/1/70	Remaining in-place reserves 1/1/70
MAIN BITUMINOUS AND GEORGES CREEK FIELDS			
Allegheny	18"	1,800	1,400
Armstrong	"	430	3,300
Beaver	14"	34	2,500
Blair	18"	35	43
Butler	14"	230	3,400
Cambria	18"	1,500	3,900
Cameron	"	2	59
Centre	"	140	370
Clarion	"	190	1,900
Clearfield	"	680	3,300
Clinton	"	40	75
Elk	"	100	460
Fayette (not specified but 24" or less)		2,300	5,300
Greene	18"	610	8,900
Indiana	"	900	5,400
Jefferson	"	430	2,900
Lawrence	14"	44	740
McKean	18"	1	420
Mercer	"	110	390
Somerset	"	610	5,500
Venango	"	17	380
Washington	"	1,600	8,900
Westmoreland	"	1,800	4,600
Total	14" & 18"	14,000	64,000

TABLE 2.1.1.-3

In-place Reserves of the Pittsburgh Coal as of January 1, 1970 (Millions of tons)

County	Remaining in-place reserves over 14 in. (millions of tons)	Remaining in-place reserves over 28 in.* (millions of tons)
Allegheny	36	36
Armstrong	10	10
Beaver	Exhausted	Exhausted
Fayette	19	19
Greene	3,700	3,700
Indiana	5	5
Somerset	31	31
Washington	3,200	3,200
Westmoreland	140	140
Total for Pa.	7,100	7,100*

* Over 99% of the reserves over 28 inches thick are also over 42 inches thick.

Figures are rounded to first two digits (or first digit if 9 million or less). Figures do not add to total due to independent rounding.

From Edumunds, 1972

TABLE 2.1.1.-4

Estimated strippable coal reserves of 16 southwestern Pennsylvania counties, January 1, 1968, by seams (thousands of short tons).[1]

Coal Seam	Remaining coal in place with 0-120 feet of overburden	Remaining coal in place with 0-120 feet of overburden less 20% mining loss	Remaining coal in place with overburden = to 15× average seam thickness less 20% mining loss
Washington	76,100	60,900	34,700
Waynesburg	188,400	150,700	71,800
Sewickley	22,900	18,400	9,600
Redstone	65,200	52,200	20,100
Pittsburgh	72,000	57,600	37,900
Brush Creek	1,000	800	300
Mahoning	5,900	4,700	2,000
Upper Freeport	596,800	477,300	194,500
Lower Freeport	312,000	249,600	99,800
Upper Kittanning	154,300	123,500	46,700
Middle Kittanning	145,900	116,800	41,900
Lower Kittanning	306,000	244,800	89,900
Clarion[2]	95,900	76,400	30,200
Brookville[3]	142,700	114,200	46,100
Upper Mercer[4]	34,200	27,400	11,300
Lower Mercer	29,900	24,000	8,300
Quakertown	800	600	200
Sharon	22,900	18,300	7,000
Total	2,272,500	1,818,200	752,300

[1] Adapted from Table A62 of *The reserves of bituminous coal and lignite for strip mining in the United States*, U. S. Bureau of Mines, Information Circular 8531.

[2] Referred to as "Upper Clarion" in Table 59 of U. S. Bureau of Mines report.

[3] Revised from Table 59 of U. S. Bureau of Mines report by adding "Lower Clarion" tonnage from Clarion County and subtracting "Brookville" tonnage from Clarion County.

[4] Revised from Table 59 of U. S. Bureau of Mines report by adding "Brookville" tonnage from Clarion County and "Homewood" tonnage from Lawrence County.

From Edmunds, 1972

TABLE 2.1.1.-5

Estimated strippable coal reserves of 16 southwestern Pennsylvania counties, January 1, 1968, by counties and seams (thousands of short tons).[1]

County Seam	Ave. seam thickness (inches)	Remaining coal in place with 0-120 feet of overburden	Remaining coal in place with 0-120 feet of overburden less 20% mining loss	Remaining coal in place with overburden = to 15× average seam thickness, less 20% mining loss
Allegheny Co.				
Redstone	39	30,900	24,700	9,600
Pittsburgh	63	7,800	6,200	3,900
Upper Freeport ..	68	9,500	7,600	5,200
Total		48,200	38,500	18,700
Armstrong Co.				
Pittsburgh	66	5,000	4,000	2,600
Upper Freeport ..	38	94,400	75,500	28,700
Lower Freeport ..	41	42,900	34,300	14,100
Upper Kittanning	32	18,700	15,000	4,800
Lower Kittanning	36	55,900	44,700	16,100
Total		216,900	173,500	66,300
Beaver Co.				
Brush Creek	36	1,000	800	300
Mahoning	42	5,900	4,700	2,000
Upper Freeport ..	42	50,900	40,700	17,100
Lower Freeport ..	36	11,100	8,900	3,200
Middle Kittanning	36	4,200	3,400	1,200
Lower Kittanning	42	6,500	5,200	2,200
Total		79,600	63,700	26,000
Butler Co.				
Upper Freeport ..	41	125,300	100,200	41,100
Lower Freeport ..	43	52,000	41,600	17,900
Middle Kittanning	37	75,200	60,200	22,300
Clarion	43	54,400	43,500	18,700
Total		306,900	245,500	100,000
Cambria Co.				
Upper Freeport ..	36	22,000	17,600	6,300
Lower Freeport ..	35	19,300	15,400	5,400
Upper Kittanning	37	23,200	18,600	6,900
Middle Kittanning	35	1,400	1,100	400
Lower Kittanning	39	26,900	21,500	8,400
Total		92,800	74,200	27,400
Clarion Co.				
Upper Freeport ..	43	26,700	21,400	9,200
Lower Freeport ..	46	28,400	22,700	10,400
Middle Kittanning	35	6,500	5,200	1,800
Lower Kittanning	35	57,000	45,600	16,000
Clarion ("Upper Clarion")	35	41,100	32,900	11,500
Brookville ("Lower Clarion")	34	53,800	43,000	14,600
Upper Mercer ("Brookville")	41	23,200	18,600	7,600
Total		236,700	189,400	71,100

(continued)

Table 2.1.1.-5 (continued)

County Seam	Ave. seam thickness (inches)	Remaining coal in place with 0-120 feet of overburden	Remaining coal in place with 0-120 feet of overburden less 20% mining loss	Remaining coal in place with overburden = to 15 × average seam thickness, less 20% mining loss
Clearfield Co.				
Upper Freeport ..	33	40,800	32,600	10,800
Lower Freeport ..	38	83,700	67,000	25,500
Upper Kittanning	36	47,400	37,900	13,700
Middle Kittanning	34	39,100	31,300	10,600
Lower Kittanning	37	70,300	56,200	20,800
Brookville	44	17,500	14,000	6,200
Total		298,800	239,000	87,600
Fayette Co.				
Waynesburg	44	41,200	33,000	14,500
Sewickley	51	14,200	11,400	5,800
Pittsburgh	85	4,100	3,300	2,800
Upper Freeport ..	42	62,600	50,100	21,000
Total		122,100	97,800	44,100
Greene Co.				
Waynesburg	62	53,400	42,700	26,500
Sewickley	54	8,700	7,000	3,800
Pittsburgh	76	8,200	6,600	5,000
Total		70,300	56,300	35,300
Indiana Co.				
Pittsburgh	62	700	600	400
Upper Freeport ..	44	52,000	41,600	18,300
Lower Freeport ..	40	22,000	17,900	7,200
Lower Kittanning	38	20,200	16,200	6,200
Total		93,300	76,300	32,100
Jefferson Co.				
Upper Freeport ..	37	43,300	34,600	12,800
Lower Freeport ..	40	29,100	23,300	9,300
Lower Kittanning	30	28,200	22,600	6,800
Brookville	39	29,200	23,400	9,100
Total		129,800	103,900	38,000
Lawrence Co.				
Upper Freeport ..	42	2,400	1,900	800
Lower Freeport ..	42	8,700	7,000	2,900
Middle Kittanning	36	19,500	15,600	5,600
Lower Kittanning	36	2,100	1,700	600
Homewood	42	9,000	7,200	3,000
Upper Mercer ...	42	2,000	1,600	700
Lower Mercer ...	42	1,700	1,400	600
Quakertown	36	800	600	200
Total		46,200	37,000	14,400

(continued)

Table 2.1.1.-5 (continued)

County Seam	Ave. seam thickness (inches)	Remaining coal in place with 0-120 feet of overburden	Remaining coal in place with 0-120 feet of overburden less 20% mining loss	Remaining coal in place with overburden = to 15 × average seam thickness, less 20% mining loss
Mercer Co.				
Brookville	48	42,200	33,800	16,200
Lower Mercer ...	34	28,200	22,600	7,700
Sharon	38	22,900	18,300	7,000
Total		93,300	74,700	30,900
Somerset Co.				
Redstone	41	9,600	7,700	3,200
Pittsburgh	41	9,500	7,600	3,100
Upper Freeport ..	40	38,100	30,500	12,200
Lower Freeport ..	34	14,400	11,500	3,900
Upper Kittanning	41	65,000	52,000	21,300
Lower Kittanning	41	38,900	31,100	12,800
Total		175,500	140,400	56,500
Washington Co.				
Washington	57	76,100	60,900	34,700
Waynesburg	41	93,800	75,000	30,800
Redstone	35	7,200	5,800	2,000
Pittsburgh	65	27,300	21,800	14,200
Total		204,400	163,500	81,700
Westmoreland Co.				
Redstone	38	11,700	14,000	5,300
Pittsburgh	79	9,400	7,500	5,900
Upper Freeport ..	48	28,800	23,000	11,000
Total		55,700	44,500	22,200
Grand Total		2,272,500	1,818,200	752,300

[1] Unpublished data from U. S. Bureau of Mines.

From Edmunds, 1972

TABLE 2.1.1.-6

Estimated strippable coal reserves of 16 southwestern Pennsylvania counties, January 1, 1968, by seam and sulfur content (thousands of short tons).[1,2]

Seam	Low Sulfur[2] (0-1%)	Medium Sulfur[2] (1-2%)	High Sulfur[2] (over 2%)
Washington	—	—	34,700
Waynesburg	—	—	71,800
Sewickley	—	—	9,600
Redstone	—	12,800[6]	7,300
Pittsburgh	—	32,500[7]	5,400
Brush Creek	—	—	300
Mahoning	—	—	2,000
Upper Freeport	—	52,800[8]	141,700
Lower Freeport	—	60,600[9]	38,400
Upper Kittanning	—	21,300[10]	25,400
Middle Kittanning	—	—	41,900
Lower Kittanning	—	23,400[11]	66,500
Clarion[3]	—	18,700[12]	11,200
Brookville[4]	—	—	46,100
Upper Mercer[5]	—	—	17,600
Lower Mercer	—	—	8,300
Quakertown	—	—	200
Sharon	—	7,000[13]	—
Total	—	229,100	523,200

[1] Adapted from Table A64 of *The reserves of bituminous coal and lignite for strip mining in the United States*, U. S. Bureau of Mines, Information Circular 8531.

[2] Based on the *average* "as received" sulfur content of each seam for each county. The *entire* tonnage of each seam for each county is assigned to the sulfur category corresponding to that seam's *average* sulfur content in that county.

[3] Referred to as "Upper Clarion" in Table 61 of U. S. Bureau of Mines report.

[4] Revised from Table 61 of U. S. Bureau of Mines report by adding "Lower Clarion" tonnage from Clarion County and subtracting "Brookville" tonnage from Clarion County.

[5] Revised from Table 61 of U. S. Bureau of Mines report by adding "Brookville" tonnage from Clarion County and "Homewood" tonnage from Lawrence County.

[6] Allegheny and Somerset Counties.

[7] Allegheny, Armstrong, Fayette, Somerset, Washington, and Westmoreland Counties.

[8] Allegheny, Cambria, Clearfield, Indiana, and Somerset Counties.

[9] Beaver, Butler, Clearfield, Indiana, Lawrence, and Somerset Counties.

[10] Somerset County.

[11] Beaver, Cambria, and Somerset Counties.

[12] Butler County.

[13] Mercer County.

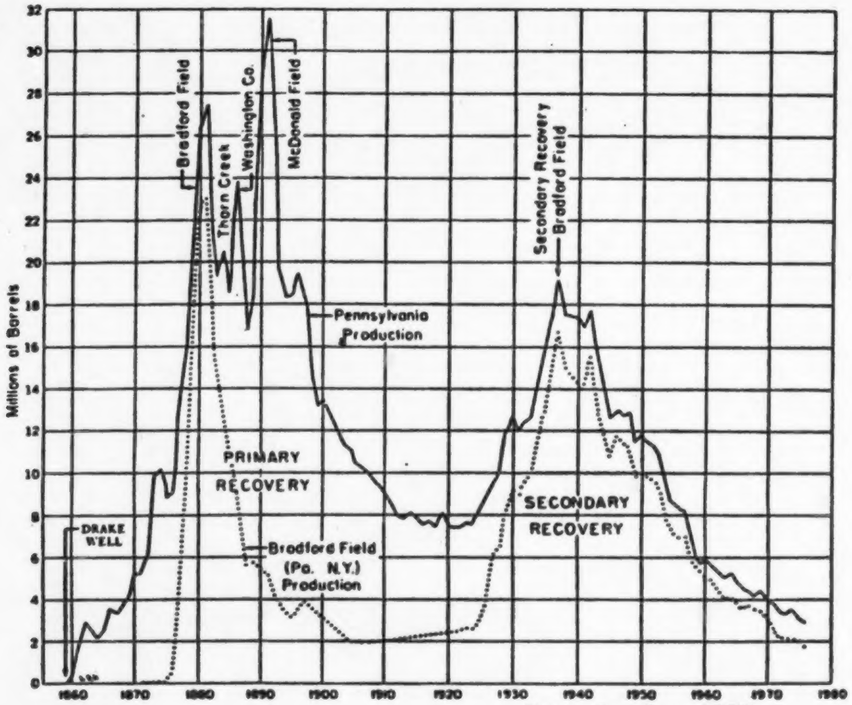
From Edmunds, 1972

		Production				*Reserves*		
		1976	*1975*	*% Change*	*Cumulative to 12/31/76*	*1976*	*1975*	*% Change*
Oil (1,000 bbls.)	Penna. Grade	2,887	3,132	- 8	1,288,944	49,975	47,377	+ 5
	Corning Grade	63	67	- 6	620	588	651	-10
	TOTAL OIL	2,950	3,199	- 8	1,289,564	50,563	48,028	+ 5
	Natural Gas Liquids (1,000 bbls.)	69	65	+ 6	---	446	515	-13
Gas (MMcf)	Shallow	76,632	72,620	+ 6	---	---	---	---
	Deep	13,342	12,152	+10	---	---	---	---
	TOTAL GAS	89,974	84,772	+ 6	9,013,560	1,651,898*	1,682,460*	- 2
	Stored Recoverable Gas					512,861	596,324	-14

*Stored Recoverable Gas Included

From Lytle, 1977

TABLE 2.1.1.-7 Production and reserves of oil and gas in Pennsylvania



From Lytle, 1977

FIGURE 2.1.1.-11 Annual production of crude oil in Pennsylvania

From Pennsylvania Department of Environmental Resources, COWAMP report, Study Area 9 (1975)

Weather Station	County	Monthly Mean Precipitation - Inches (Recorded 1941-1970)																Annual
		Jan.	Feb.	March	Winter Average	April	May	June	Spring Average	July	Aug.	Sept.	Summer Average	Oct.	Nov.	Dec.	Fall Average	
Pittsburgh AP WSO2	Allegheny	2.79	2.35	3.60	2.91	3.40	3.63	3.48	3.50	3.84	3.15	2.52	3.17	2.52	2.47	2.48	2.49	36.23
Pittsburgh City WSO	Allegheny	2.61	2.29	3.58	2.82	3.44	3.59	3.74	3.59	3.78	3.18	2.53	3.16	2.47	2.49	2.52	2.49	36.22
Acmetonia Lock 3	Allegheny	2.91	2.59	3.73	3.07	3.83	3.69	3.89	3.80	4.13	3.65	2.68	3.48	2.82	2.90	2.74	2.82	39.56
McKeesport	Allegheny	2.61	2.25	3.40	2.75	3.41	3.63	3.81	3.61	3.71	3.34	2.57	3.20	2.29	2.52	2.43	2.41	35.97
Bruceton	Allegheny	2.67	2.30	3.38	2.78	3.45	3.63	4.24	3.77	4.19	3.56	2.79	3.51	2.42	2.59	2.60	2.53	37.82
Putneyville 2SE DAM	Armstrong	3.05	2.78	3.72	3.18	4.09	4.27	3.76	4.04	4.43	3.75	3.32	3.83	3.22	3.25	2.96	3.14	42.60
Kittanning Lock 7	Armstrong	2.97	2.73	3.63	3.11	3.87	4.06	3.61	3.84	3.96	3.59	2.92	3.49	2.94	3.05	2.99	2.99	40.32
Sagamore 1S	Armstrong	3.14	2.59	3.82	3.18	3.91	4.47	3.73	4.03	4.30	3.73	3.25	3.76	3.21	3.33	3.06	3.20	42.54
Whiterburg	Armstrong	3.04	2.68	3.56	3.09	3.90	4.06	4.02	3.99	4.34	3.63	3.15	3.70	3.06	3.24	3.07	3.12	41.75
Ford City 4S DAM	Armstrong	2.74	2.48	3 46	2.89	3.70	4.04	3.74	3.82	4.26	3.81	2.98	3.68	2.98	2.89	2.66	2.84	39.74
Schenley Lock 5	Armstrong	2.88	2.65	4.01	3.18	3.87	3.92	3.71	3.83	3.96	3.56	2.86	3.46	2.74	2.90	2.80	2.81	39.86
Natrona Lock 4	Armstrong	2.78	2.47	3.61	2.95	3.81	3.78	3.81	3.80	4.20	3.67	2.70	3.52	2.74	2.79	2.64	2.72	39.00
Montgomery L & D	Beaver	2.64	2.26	3.43	2.77	3.60	3.71	3.37	3.56	4.01	3.16	2.70	3.29	2.62	2.64	2.42	2.56	36.56
Beaver Falls	Beaver	2.51	2.15	3.10	2.58	3.18	3.66	3.62	3.48	3.79	3.14	2.68	3.20	2.70	2.49	2.29	2.49	35.31
Newell	Fayette	2.82	.32	3.55	3.89	3.76	3.99	3.83	3.86	4.17	3.53	3.07	3.59	2.45	2.84	2.68	2.65	39.01
Uniontown 1 NE	Fayette	2.96	2.43	3.65	3.01	3.62	4.24	4.25	4.03	3.97	3.63	3.05	3.55	2.63	2.91	2.71	2.75	40.05
Connellsville 3	Fayette	2.78	2.28	3.46	2.84	3.66	4.30	4.07	4.01	4.31	3.89	3.23	3.81	2.59	2.77	2.73	2.69	40.07
Confluence 1NW	Fayette	3.16	2.82	3.95	3.31	3.74	4.06	4.32	4.04	4.58	3.98	3.12	3.89	2.77	2.97	3.20	2.98	42.67
Waynesburg 1E	Greene	2.71	2.26	3.56	2.84	3.54	4.12	3.86	3.84	4.36	3.57	2.95	3.62	2.46	2.61	2.54	2.53	38.54
Greensboro Lock 7	Greene	2.77	2.35	3.54	2.88	3.44	3.76	3.95	3.71	4.45	3.93	3.00	3.79	2.40	2.65	2.56	2.53	38.80
Marion Center 2SE	Indiana	3.41	2.98	4.03	3.47	4.23	4.60	4.14	4.32	4.58	4.00	3.22	3.93	3.16	3.53	3.44	3.37	45.32
Creekside	Indiana	3.02	2.62	3.61	3.08	3.94	4.24	4.01	4.06	4.76	3.78	3.08	3.87	2.92	3.31	2.93	3.05	42.22
Blairsville 6ENE	Indiana	3.63	3.15	4.17	3.65	4.37	4.79	4.77	4.64	4.88	4.17	3.25	4.10	3.19	3.65	3.56	3.46	47.58
Claysville 3SE	Washington	2.83	2.38	3.57	2.92	3.64	4.12	3.68	3.81	4.25	3.48	3.08	3.60	2.59	2.73	2.54	2.62	38.89
Charleroi	Washington	2.79	2.35	3.72	2.95	3.66	3.83	3.41	3.63	3.94	3.45	2.91	3.43	2.47	2.79	2.63	2.63	37.95
Derry	Westmoreland	3.14	2.57	3.80	3.17	4.34	4.37	3.80	4.50	5.01	3.99	3.10	4.03	3.11	3.41	3.07	3.19	44.71
New Stanton	Westmoreland	3.10	2.64	3.63	3.12	3.51	4.10	3.81	3.80	4.04	4.00	3.16	3.73	2.84	2.79	2.87	2.83	40.49
Donora	Westmoreland	2.47	2.21	3.50	2.72	3.36	3.84	3.57	3.59	3.75	3.66	2.72	3.37	2.60	2.52	2.35	2.49	36.55
Vandergrift	Westmoreland	2.70	2.48	3.55	2.91	3.73	3.93	4.04	3.90	4.27	3.69	2.82	3.59	3.01	2.81	2.66	2.82	39.69
Average		2.88	2.49	3.63	3.00	3.72	4.01	3.90	3.88	4.21	3.64	2.95	3.60	2.76	2.89	2.76	2.80	39.84

Table 2.1.2.-1 Monthly mean precipitation at 30 weather stations in ORBES region

From Pennsylvania Department of Environmental Resources, COWAMP report, Study Area 8 (1975)

WEATHER STATION	COUNTY	MONTHLY MEAN PRECIPITATION-INCHES (RECORDED 1941-1970)																
		JAN.	FEB.	MARCH	WINTER AVERAGE	APRIL	MAY	JUNE	SPRING AVERAGE	JULY	AUG.	SEPT.	SUMMER AVERAGE	OCT.	NOV.	DEC.	FALL AVERAGE	ANNUAL
BRADFORD 4W RES.	McKEAN	2.93	2.56	3.44	2.97	4.06	4.34	4.47	4.29	4.71	3.54	3.87	4.04	3.43	4.16	3.13	3.57	44.64
BRADFORD F.A.A. A.P.	McKEAN	3.17	2.85	3.45	3.15	3.79	4.20	3.85	3.94	4.29	3.36	3.48	3.70	3.16	3.56	3.01	3.24	42.15
KANE 1NNE	McKEAN	3.25	2.81	3.67	3.24	4.14	4.71	4.17	4.34	4.93	3.78	3.94	4.21	3.44	3.78	3.16	3.45	45.76
WARREN	WARREN	2.71	2.40	3.333	2.81	3.70	4.22	4.40	4.10	4.46	3.63	3.58	3.89	3.42	3.83	3.01	3.42	42.69
MEADVILLE 1S	CRAWFORD	2.79	2.46	3.32	2.85	3.77	4.20	4.23	4.06	4.50	3.71	3.09	3.76	3.67	3.50	2.86	3.34	42.10
JAMESTOWN 2NW	CRAWFORD	2.55	2.16	3.06	2.59	3.75	4.08	3.93	3.92	3.88	3.23	3.04	3.38	3.12	3.15	2.47	2.91	38.42
* FRANKLIN	VENANGO	2.85	2.33	3.12	2.76	3.88	4.22	3.88	3.99	4.40	3.32	3.10	3.60	3.17	3.43	2.63	3.07	40.33
* TIONESTA 2SE DAM	FOREST	2.98	2.61	3.46	3.01	4.17	4.56	3.80	4.17	4.35	3.32	3.12	3.59	3.32	3.50	2.94	3.25	42.13
* CLARION 3SW	CLARION	3.02	2.67	3.58	3.09	4.06	4.33	3.88	4.09	4.57	3.47	2.98	3.67	3.12	3.34	2.91	3.12	41.93
* RIDGWAY	ELK	2.72	2.40	3.40	2.84	3.86	4.45	3.80	4.03	4.59	3.62	3.22	3.81	2.92	3.27	2.82	3.00	41.07
* GREENVILLE	MERCER	2.79	2.28	3.25	2.77	3.94	4.04	4.06	4.01	3.94	3.41	2.65	3.33	3.23	3.25	2.62	3.00	39.36
* FARRELL-SHARON	MERCER	2.64	2.18	2.95	2.58	3.41	3.85	3.63	3.63	3.55	3.47	2.43	3.15	2.62	2.87	2.46	2.65	36.04
* NEW CASTLE 1N	LAWRENCE	2.74	2.32	3.28	2.78	3.47	3.87	3.73	3.69	4.09	3.18	2.71	3.32	2.83	2.78	2.43	2.67	37.41
AVERAGE		2.86	2.46	3.33	2.88	3.85	4.24	3.99	4.02	4.33	3.46	3.17	3.65	3.19	3.41	2.80	3.13	41.07

* Stations in ORBES region

Table 2.1.2.-2 Monthly mean precipitation at 7 weather stations in ORBES region.

From Technical Paper No. 15, U.S. Weather Bureau, 1956
in Pa. DER, Cowamp report, Study Areas 8 and 9, 1975

Town	County	1 Hr	2 Hrs	3 Hrs	6 Hrs	12 Hrs	24 Hrs
Butler	Butler	1.80	2.70	2.85	3.11	3.17	3.86
Rochester	Beaver	1.53	1.80	2.32	3.03	3.21	3.21
Ford City Dam	Armstrong	1.69	1.97	2.14	2.39	2.96	3.92
Vandergrift	Westmoreland	1.89	1.89	1.89	1.92	2.07	2.90
Indiana	Indiana	2.12	2.22	2.40	2.83	2.87	4.12
Strongstown	Indiana	1.87	2.36	2.64	3.26	3.27	4.12
Murrysville	Westmoreland	1.30	1.84	2.18	2.37	2.46	3.24
Greensburg	Westmoreland	1.57	2.26	2.29	2.45	2.75	3.56
Boswell	Westmoreland	2.57	2.77	2.77	2.77	2.77	3.13
Pittsburgh City	Allegheny	2.09	2.29	2.35	2.53	2.53	3.76
Pittsburgh	Allegheny	1.71	2.12	2.14	2.45	2.93	3.14
Washington	Washington	1.80	2.45	3.12	3.48	3.55	4.16
Charleroi	Washington	1.30	1.53	1.81	2.27	2.44	2.53
Connellsville	Fayette	2.21	2.92	2.92	2.94	3.47	4.08
Confluence Dam	Fayette	1.75	1.76	1.84	2.22	3.09	3.22

Town	County	1 Hour	2 Hrs.	3 Hrs.	12 Hrs.	24 Hrs.
*Meadville	Crawford	2.21	2.23	3.23	3.39	4.38
*Titusville	Crawford	2.00	2.33	2.53	3.43	3.88
*Youngsville	Warren	1.75	1.87	1.93	2.35	3.13
*Scandia	Warren	1.40	2.34	2.35	2.83	2.83
*Sheffield	Warren	2.20	2.40	2.75	3.04	3.76
Franklin	Venango	1.74	2.41	2.62	2.87	3.37
Tionesta Dam	Forest	1.65	1.66	1.66	2.34	2.72
Marienville	Forest	2.10	2.17	2.21	3.20	3.41
*Kane	McKean	1.78	1.79	1.79	2.99	3.94
*Smethport	McKean	2.14	2.63	2.83	3.12	6.68
Ridgway	Elk	1.35	1.94	2.06	2.61	3.62
Clarion	Clarion	1.74	2.20	2.48	2.75	3.88
Parker's Landing	Clarion	1.78	2.40	2.48	2.75	3.88
Allens Mills	Jefferson	2.05	2.30	2.35	3.44	3.89
Punxsutawney	Jefferson	1.27	2.00	2.07	3.27	3.32

*Not in ORBES region

Table 2.1.2.-3 Maximum amount of precipitation at various intervals

Table 2,1,3,-1 Soil properties and limita

SOIL SERIES NAME	NATURAL DRAINAGE AND PHYSIOGRAPHIC POSITION	TEXTURE AND/OR NATURE OF SOIL PROFILE			DOMINANT SLOPE RANGE 2/ (Percent)	DEPTH TO ROCK (Feet)	DEPTH TO SEASONAL HIGH WATER TABLE (Feet)	PERMEABILITY 3/ (inches per hour)
		SURFACE	SUBSOIL	SUBSTRATUM				
CALVIN	Well drained (Uplands)	Silt loam (shaly)	Silt loam (very shaly)	Red shale and siltstone	3 - 20	1.5 - 3.0	6+	2.0 - 6.0
CANADICE	Poor (Late plains)	Silt loam	Silty clay	Laminated silty clay and silty clay loam	0 - 5	10+	0 - 1 (Dec.-June)	0.06
CANEADEA	Somewhat poor (Uplands)	Silt loam	Silty clay	Laminated silty clay and silty clay loam	2 - 8	10+	0.5 - 1.5 (perched, Dec.-May)	0.06 Below 12 in. depth
CANFIELD	Moderately well (Uplands)	Silt loam	Loam to clay loam	Loam till	2 - 6	10+	1.5 - 3.0 (perched, Nov.-May)	0.06 - 2.0 (0.2-0.6 in the fragipan)
CAVODE	Somewhat poor (Uplands)	Silt loam	Silty clay loam (somewhat shaly)	Shaly silty clay loam over clay shale	0 - 15	3 - 6	0.5 - 1.5 (perched, Oct.-May)	0.08 - 0.1
CHENANGO	Well drained (Uplands)	Gravelly silt loam	Very gravelly silt loam	Water-sorted sand and gravel	0 - 20	10+	6+	0.6 - 6.0
CHILI	Well drained (Terraces and kames)	Loam	Gravelly sandy loam, clay loam	Gravel and sand with some fines	2 - 12	10+	4	2.0 - 0.6
COOKPORT	Well drained (Uplands)	Loam	Clay loam	Channery sandy loam over sandstone	0 - 12	3.5 - 4.0	1.0 - 2.5 (perched, Dec.-Apr.)	0.2 - 0.6 in the fragipan layer
CULLEOKA	Well drained (Uplands)	Silt loam	Silt loam (flaggy)	Very flaggy silty clay loam over siltsone or sandstone bedrock	3 - 20	1.5 - 3.0	None	2.0 - 6.0
DEKALB	Well drained (Uplands)	Fine sandy loam (stony)	Fine sandy loam (very stony)	Sandstone bedrock	5 - 50	2.5	6+	6.0 - 20.0
ERIE	Somewhat poor (Uplands)	Silt loam (channery)	Silt loam (very channery)	Channery glacial loam till	0 - 25	6+	0.5 - 1.5 (perched, Dec.-May)	0.06 - 0.2 in the fragipan layer
ERNEST	Moderately well (Uplands)	Silt loam	Silty clay loam	Silty clay loam colluvium	0 - 15	5+	1.5 - 2.5 (perched, Dec.-Apr.)	0.06 - 0.6 in the fragipan layer
GILPIN	Well drained (Uplands)	Silt loam	Silty clay loam	Siltstone and shale bedrock	8 - 65	1.5 - 3.0	3	0.6 - 2.0
GUERNSEY	Moderately well (Uplands)	Silt loam	Silty clay loam	Clay	12 - 35	5 - 10	1.5 - 4.0 (perched, Jan.-Apr.)	0.06 - 0.6 in the substrata
HANOVER	Well drained (Uplands)	Silt loam	Loam, silt loam	Loam till	5 - 30	10+	2.0 - 4.0 (perched, Nov.-Mar.)	0.02 - 0.6 in the fragipan layer
HAZLETON	Well drained (Uplands)	Sandy loam (stony)	Sandy loam (very stony)	Very stony sandy loam over sandstone bedrock	8 - 65	3 - 5	6+	2.0 - 6.0
HOWARD	Well drained (Uplands)	Gravelly loam	Very gravelly loam	Stratified sand and gravel	0 - 30	6+	None	0.6 - 2.0
LANGFORD	Well drained and moderately well (Uplands)	Silt loam (channery)	Loam (channery)	Channery silt loam glacial till	3 - 20	6+	1.5 - 2.0 (perched, Mar.-May)	0.6 - 0.2 in the fragipan
LICKDALE	Very poor (upland flats and depressions)	Silt loam	Sandy clay loam	Loamy sand over sandstone bedrock	0 - 3	3.5 - 6	0.0 - 0.5	0.2
LORDSTOWN	Well drained (Uplands)	Silt loam (channery)	Silt loam (channery)	Very channery loam over sandstone or siltstone	3 - 30	1.5 - 3.0	6+	0.6 - 2.0
MONONGAHELA	Moderately well (Terraces)	Silt loam	Silty clay loam, silt loam	Stratified sand, silt and clay	2 - 8	10+	1.5 - 3.0 (perched, Jan.-Apr.)	0.6 - 0.6
OQUAGA	Well drained (Uplands)	Silt loam (channery)	Silt loam (channery)	Glacial loam (very channery)	3 - 45	1.5 - 3.0	None	0.6 - 2.0
PLATEA	Somewhat poor (Uplands)	Silt loam	Silty clay loam	Silt loam	1 - 12	5+	0.5 - 2.0	0.06

Continued on next page

Table 2.1.3.-1 Soil properties and limitations affecting selected land uses

/OR NATURE OF SOIL PROFILE		DOMINANT SLOPE RANGE 2/ (Percent)	DEPTH TO ROCK (Feet)	DEPTH TO SEASONAL HIGH WATER TABLE (Feet)	PERMEABILITY 3/ (inches per hour)	ENGINEERING 4/ CLASSIFICATION (Surface Layer only)	DEGREES AND MAJOR KINDS OF LIMITAT			
SUBSOIL	SUBSTRATUM						SEPTIC TANK FILTER FIELDS	SANITARY LAND FILL	DWELLINGS WITH BASEMENTS	INDUSTRIAL USE
Silt loam (very shaly)	Red shale and siltstone	3 - 20	1.5 - 3.0	6+	2.0 - 6.0	ML, CL or GM	Severe r,s	Severe r,s	Moderate s	Moderate s
Silty clay	Laminated silty clay and silty clay loam	0 - 5	10+	0 - 1 (Dec.-June)	0.06	CL, ML	Severe p,w	Severe w	Severe w	Severe w
Silty clay	Laminated silty clay and silty clay loam	2 - 8	10+	0.5 - 1.5 (perched, Dec.-May)	0.06 Below 12 in. depth	WL, CL or WN	Severe p,w	Severe w	Severe w,u	Severe w,u
Loam to clay loam	Loam till	2 - 6	10+	1.5 - 3.0 (perched, Nov.-May)	0.06 - 2.0 (0.2-0.6 in the fragipan)	ML	Severe p,w	Severe w	Moderate w	Moderate w
Silty clay loam (somewhat shaly)	Shaly silty clay loam over clay shale	0 - 15	3 - 6	0.5 - 1.5 (perched, Oct.-May)	0.08 - 0.1	ML, CL	Severe p,w	Severe w	Severe w	Severe w,f,s
Very gravelly silt loam	Water-sorted sand and gravel	0 - 20	10+	6+	0.6 - 6.0	ML, SM or GM	Slight to moderate s	Severe (seepage)	Slight to moderate s	Slight to moderate s
Gravelly sandy loam, clay loam	Gravel and sand with some fines	2 - 12	10+	4	2.0 - 0.6	ML, CL	Slight	Severe (seepage)	Slight	Slight
Clay loam	Channery sandy loam over sandstone	0 - 12	3.5 - 4.0	1.0 - 2.5 (perched, Dec.-Apr.)	0.2 - 0.6 in the fragipan layer	ML, CL	Severe p,w	Severe w	Severe w	Moderate w,s
Silt loam (flaggy)	Very flaggy silty clay loam over siltsone or sandstone bedrock	3 - 20	1.5 - 3.0	None	2.0 - 6.0	ML, CL	Severe r,s	Slight to moderate s	Severe r,s	Moderate r,s
Fine sandy loam (very stony)	Sandstone bedrock	5 - 30	2.5	6+	6.0 - 20.0	SM, GM, ML	Severe r,s	Severe s,p	Severe s,r	Severe s,r
Silt loam (very channery)	Channery glacial loam till	0 - 25	6+	0.5 - 1.5 (perched, Dec.-May)	0.06 - 0.2 in the fragipan layer	Gm, ML, or CL	Severe p,w	Severe w,s	Severe w,s	Severe w,s
Silty clay loam	Silty clay loam colluvium	0 - 15	5+	1.5 - 2.5 (perched, Dec.-Apr.)	0.06 - 0.6 in the fragipan layer	ML, CL	Severe p,w	Severe w,s	Severe w,s	Moderate to severe w,s
Silty clay loam	Siltstone and shale bedrock	8 - 65	1.5 - 3.0	3	0.6 - 2.0	ML, CL, or GM	Severe r,s	Severe r,s	Severe r,s	Severe r,s
Silty clay loam	Clay	12 - 35	5 - 10	1.5 - 4.0 (perched, Jan.-Apr.)	0.06 - 0.6 in the substrata	ML, ML-CL	Severe p,w,s	Moderate w,s	Severe u,s,w	Severe u,s,w
Loam, silt loam	Loam till	5 - 30	10+	2.0 - 4.0 (perched, Nov.-Mar.)	0.02 - 0.6 in the fragipan layer	ML, ML-CL	Severe p,w,s	Moderate to severe w,s	Severe w,s	Moderate to severe w,s
Sandy loam (very stony)	Very stony sandy loam over sandstone bedrock	8 - 65	3 - 5	6+	2.0 - 6.0	ML, GW, or SW	Moderate to severe s,r	Severe (seepage)	Moderate to severe s,r	Moderate to severe s,r
Very gravelly loam	Stratified sand and gravel	0 - 30	6+	None	0.6 - 2.0	SM, GM, or ML	Slight to severe s	Moderate to severe (seepage).	Slight to moderate s	Slight to severe s
Loam (channery)	Channery silt loam glacial till	3 - 20	6+	1.5 - 2.0 (perched, Mar.-May)	0.6 - 0.2 in the fragipan	ML, CL or GM	Severe p	Severe w	Slight to moderate w	Slight to moderate w
Sandy clay loam	Loamy sand over sandstone bedrock	0 - 3	3.5 - 6	0.0 - 0.5	0.2	ML	Severe w,p	Severe w	Severe w	Severe w
Silt loam (channery)	Very channery loam over sandstone or siltstone	3 - 30	1.5 - 3.0	6+	0.6 - 2.0	ML, CL, or GM	Severe r,s	Moderate to severe r,s	Severe r,s	Moderate to severe r,s
Silty clay loam, silt loam	Stratified sand, silt and clay	2 - 8	10+	1.5 - 3.0 (perched, Jan.-Apr.)	0.6 - 0.6	ML, SM	Severe p,w	Moderate w	Moderate w	Slight to moderate s
Silt loam (channery)	Glacial loam (very channery)	3 - 45	1.5 - 3.0	None	0.6 - 2.0	ML, CL, or G	Severe r,s	Moderate to severe r,s	Severe r,s	Severe r,s
Silty clay loam	Silt loam	1 - 12	5+	0.5 - 2.0	0.06	ML, ML-CL	Severe p	Moderate w	Severe w	Moderate w,f

imitations affecting selected land uses

LITY 3/ per	ENGINEERING 4/ CLASSIFICATION (Surface Layer only)	DEGREES AND MAJOR KINDS OF LIMITATIONS 5/						REMARKS
		SEPTIC TANK FILTER FIELDS	SANITARY LAND FILL	DWELLINGS WITH BASEMENTS	INDUSTRIAL USE	LOCAL STREETS AND PARKING LOTS	AGRICULTURE (Cultivated crops)	
0	ML, CL or GM	Severe r,s	Severe r,s	Moderate s	Moderate s	Slight to moderate s	Moderate to severe r,s,d	Soils on favorable topography are in cropland, pasture and idle land. Shaly and steep soils mainly in woodland.
	CL, ML	Severe p,w	Severe w	Severe w	Severe w	Severe w,u,f	Severe w	Developed on sights of old, shallow glacial lakes.
in.	WL, CL or WN	Severe p,w	Severe w	Severe w,u	Severe w,u	Severe u,f	Moderate to severe w	Soils formed in lake plain deposits. Cleared areas mainly used for pasture and hay; some small grains, corn and grapes. Woodlots contain oak, sugar maple, etc.
.0 in the	ML	Severe p,w	Severe w	Moderate w	Moderate w	Moderate u,f	Moderate w	Soil contains a strongly developed fragipan - a dense, very firm, brittle (when dry) layer that severely restricts penetration of roots and water.
.1	ML, CL	Severe p,w	Severe w	Severe w	Severe w,f,s	Severe w,f	Moderate w,s	Soil developed on broad, upland ridgetops and benches.
	ML, SM or GM	Slight to moderate s	Severe (seepage)	Slight to moderate s	Slight to moderate s	Slight to moderate s	Slight to moderate s,d	Soils formed on glacial outwash plains.
	ML, CL	Slight	Severe (seepage)	Slight	Slight	Slight to moderate s	Slight to moderate d,s	
 agi-	ML, CL	Severe p,w	Severe w	Severe w	Moderate w,s	Slight to moderate w	Moderate w	Contains a fragipan layer at depths ranging from 20 to 38 inches.
	ML, CL	Severe r,s	Slight to moderate s	Severe r,s	Moderate r,s	Moderate to severe r,s	Severe r,d,s	Surface may contain numerous rock fragments. The volume of fragments increases with depth.
.0	SM, GM, ML	Severe r,s	Severe s,p	Severe s,r	Severe s,r	Moderate to severe r,s	Severe s,r,d	
.2 layer	Gm, ML, or CL	Severe p,w	Severe w,s	Severe w,s	Severe w,s	Moderate to severe w,s	Severe c,w,s	Soil has fragipan.
.6 layer	ML, CL	Severe p,w	Severe w,s	Severe w,s	Moderate to severe w,s	Moderate f	Slight to moderate s,w	Contains a fragipan of depths of 20 to 30 inches. Soils have formed in colluvial material
	ML, CL, or GM	Severe r,s	Severe r,s	Severe r,s	Severe r,s	Moderate to severe r,s	Severe r,s,d	
.6 ub-	ML, ML-CL	Severe p,w,s	Moderate w,s	Severe u,s,w	Severe u,s,w	Severe u,s	Moderate to severe w,s	Soils developed from shale and limestone.
.6 layer	ML, ML-CL	Severe p,w,s	Moderate to severe w,s	Severe w,s	Moderate to severe w,s	Moderate to severe f,s	Moderate to severe w,s	Soil has fragipan at depth 14 to 30 inches. Developed on till plains, moraines and till-covered sandstones hills.
	ML, GW, or SW	Moderate to severe s,r	Severe (seepage)	Moderate to severe s,r	Moderate to severe s,r	Slight to severe s	Severe c,s	
	SM, GM, or ML	Slight to severe s	Moderate to severe (seepage).	Slight to moderate s	Slight to severe s	Slight to moderate w	Moderate to severe d,s	Soils occur on outwash plains, kames and eskers. Trench walls unstable due to gravelly soils. Limitations for use primarily dependent on slope.
	ML, CL or GM	Severe p	Severe w	Slight to moderate w	Slight to moderate w	Severe w,u	Moderate to severe w,c,d	Soil contains a firm brittle fragipan from 20 to 48 inches.
	ML	Severe w,p	Severe w	Severe w	Severe w	Moderate to severe r,s	Severe w	Good wild life area. Artificial drainage required to overcome limitations for engineering use.
	ML, CL, or GM	Severe r,s	Moderate to severe r,s	Severe r,s	Moderate to severe r,s	Moderate to severe r,s	Severe r,s,d	Occurs on very irregular glaciated topography. Use limitations mainly related to shallow soil and steep slopes.
	ML, SM	Severe p,w	Moderate w	Moderate w	Slight to moderate s	Moderate w	Slight to moderate w	Soil has a fragipan at depth of ranging from 18 to 30 inches.
	ML, CL, or G	Severe r,s	Moderate to severe r,s	Severe r,s	Severe r,s	Severe r,s	Severe r,s,d	Most of this soil is forested.
	ML, ML-CL	Severe p	Moderate w	Severe w	Moderate w,f	Moderate w,f	Moderate to severe w,s	Soil has fragipan. Soils form in glacial till strongly influenced by clayey shales and siltstone

Table 2.1.3.-1 (cont.)

SOIL SERIES NAME	NATURAL DRAINAGE AND PHYSIOGRAPHIC POSITION	TEXTURE AND/OR NATURE OF SOIL PROFILE			DOMINANT SLOPE RANGE 2/ (Percent)	DEPTH TO ROCK (Feet)	DEPTH TO SEASONAL HIGH WATER TABLE (Feet	PERMEABILITY 3/ (inches per hour)
		SURFACE	SUBSOIL	SUBSTRATUM				
RAVENNA	Somewhat poor (Uplands)	Silt loam	Clay loam	Loam till	5 - 50	2.5	6+	6.0 - 20.0
RAYNE	Well drained (Uplands)	Silt loam	Silt loam or silty clay loam (channery)	Channery silty clay loam	5 - 15	5 - 6	5	0.6 - 2.0
SHEFFIELD	Poor (Uplands)	Silt loam	Silt loam	Silt loam	0 - 2	5+	0 - 1 (perched, Jan.-Apr.)	0.06 in the fragipan
TYGART	Somewhat poor (Terraces)	Silt loam	Silty clay loam	Silty clay alluvium	1 - 8	5 - 10	1.0 - 1.5 (perched, Jan.-Apr.)	0.2 - 0.8 in the subsoil
UPSHUR	Well drained (Uplands)	Silt loam, silty clay	Silty clay, clay	Clay (stony)	6 - 35	3.5 - 6.0	3.5 - 6.0 (perched, Dec.-Apr.)	0.06 - 0.2 in the subsoil
VENANGO	Somewhat poor (Uplands)	Silt loam	Silt loam, silty clay loam	Loam or silt loam till	2 - 5	10+	0.5 - 1.5 (perched, Jan.-Apr.)	0.06 in the subsoil
VOLUSIA	Somewhat poor (Uplands)	Silt loam (channery)	Silt loam, loam (channery)	Channery glacial loam till	0 - 15	6+	0.5 - 1.5 (perched, Dec.-May)	0.2 in the fragipan
WAYLAND	Poor (Flood plains)	Silt loam	-	Silty clay alluvium	0 - 1	10+	0.0 - 0.5 (Nov.-June)	0.06 - 0.2 in the substrata
WEIKERT	Well drained (Uplands)	Silt loam (shaly)	Silt loam (very channery)	Very shaly silt loam over shale bedrock	3 - 40	1 - 2	None	2.0 - 6.0
WESTMORELAND	Well drained (Uplands)	Silt loam	Silty clay loam	Very channery silt loam over sandstone, shale and limestone	10 - 60	3 - 5	3 - 6 (Mar.-May)	0.6 - 2.0

1/ only the dominant soil (first named soil) of each soil association has been listed.

2/ percent dominant slope is the slope range within which 60 percent of more of this soil occurs.

3/ rating is given for the most restrictive (critical) horizon or layer. Other horizons in the same soil profile may have different ratings.

4/ the Unified Soil Classification System. *See Appendix.*

5/ DEFINITION OF RATING TERMS

Slight - relatively free of limitations or limitations easily overcome

Moderate - limitations can be overcome with good management and careful design

Severe - limitations are difficult to overcome

From U.S. Army Corps of Engineers, Environmental resources inventory of the Pittsburgh Distri

D/OR NATURE OF SOIL PROFILE		DOMINANT SLOPE RANGE 2/ (Percent)	DEPTH TO ROCK (Feet)	DEPTH TO SEASONAL HIGH WATER TABLE (Feet	PERMEABILITY 3/ (inches per hour)	ENGINEERING 4/ CLASSIFICATION (Surface Layer only)	DEGREES AND MAJOR KINDS OF LIMITA			
SUBSOIL	SUBSTRATUM						SEPTIC TANK FILTER FIELDS	SANITARY LAND FILL	DWELLINGS WITH BASEMENTS	INDUSTRIAL USE
Clay loam	Loam till	5 - 50	2.5	6+	6.0 - 20.0	ML, ML-CL	Severe w,p	Moderate w	Severe w	Moderate w
Silt loam or silty clay loam (channery)	Channery silty clay loam	5 - 15	5 - 6	5	0.6 - 2.0	ML, CL	Moderate r,s	Slight to moderate s	Moderate r,s	Moderate r,s
Silt loam	Silt loam	0 - 2	5+	0 - 1 (perched, Jan.-Apr.)	0.06 in the fragipan	ML, ML-CL	Severe p,w	Severe w	Severe w	Severe w
Silty clay loam	Silty clay alluvium	1 - 8	5 - 10	1.0 - 1.5 (perched, Jan.-Apr.)	0.2 - 0.8 in the subsoil	ML	Severe w,p	Severe w	Severe w	Moderate to severe w
Silty clay, clay	Clay (stony)	6 - 35	3.5 - 6.0	3.5 - 6.0 (perched, Dec.-Apr.)	0.06 - 0.2 in the subsoil	CL, MH, or CH	Severe s,p	Moderate to severe s	Severe z,s	Severe z,s
Silt loam, silty clay loam	Loam or silt loam till	2 - 5	10+	0.5 - 1.5 (perched, Jan.-Apr.)	0.06 in the subsoil	ML, CL-ML	Severe w,p	Moderate to severe w	Severe w	Severe w,f
Silt loam, loam (channery)	Channery glacial loam till	0 - 15	6+	0.5 - 1.5 (perched, Dec.-May)	0.2 in the fragipan	ML, CL	Severe w,p	Severe w	Severe w	Severe w,f
-	Silty clay alluvium	0 - 1	10+	0.0 - 0.5 (Nov.-June)	0.06 - 0.2 in the substrata	ML, CL	Severe w,p,x	Severe w,x	Severe w,x	Severe w,x,f
Silt loam (very channery)	Very shaly silt loam over shale bedrock	3 - 40	1 - 2	None	2.0 - 6.0	GM, ML	Severe r	Severe r,s	Severe r,s	Severe r,s
Silty clay loam	Very channery silt loam over sandstone, shale and limestone	10 - 60	3 - 5	3 - 6 (Mar.-May)	0.6 - 2.0	ML, CL	Moderate to severe s,r	Moderate to severe s	Moderate s	Moderate s

soil association has been listed.

which 60 percent or more of this soil occurs.

al) horizon or layer. Other horizons in the same soil profile may have different ratings.

s.

tations easily overcome

management and careful design

SOIL CH

c	poor
d	drou
f	high
p	slow
r	shal
s	slop
u	low
w	seas
x	floo
z	high

rs, Environmental resources inventory of the Pittsburgh District, 1976

ENGINEERING 4/ CLASSIFICATION (Surface Layer only)	DEGREES AND MAJOR KINDS OF LIMITATIONS 5/						REMARKS
	SEPTIC TANK FILTER FIELDS	SANITARY LAND FILL	DWELLINGS WITH BASEMENTS	INDUSTRIAL USE	LOCAL STREETS AND PARKING LOTS	AGRICULTURE (Cultivated crops)	
ML, ML-CL	Severe w,p	Moderate w	Severe w	Moderate w	Moderate w,f	Slight	
ML, CL	Moderate r,s	Slight to moderate s	Moderate r,s	Moderate r,s	Moderate f,s	Moderate d,s	Formed in materials weathered from shale, siltstone and sandstone.
ML, ML-CL	Severe p,w	Severe w	Severe w	Severe w	Severe w,f	Moderate w	Soil has a fragipan. Developed in glacial till on large flats and upland depressions.
ML	Severe w,p	Severe w	Severe w	Moderate to severe w	Moderate to severe w,f	Moderate w	Soil developed in acid material washed from shale, sandstones and siltstone uplands.
CL, MH, or CH	Severe s,p	Moderate to severe s	Severe z,s	Severe z,s	Severe z,s	Severe s,d	Formed in material weathered from shale, or siltstone.
ML, CL-ML	Severe w,p	Moderate to severe w	Severe w	Severe w,f	Severe w,f	Moderate w	Soils developed in glacial till.
ML, CL	Severe w,p	Severe w	Severe w	Severe w,f	Moderate w	Moderate to severe w,c	Contains a fragipan at depths ranging from 10 - 20 inches. Soils have developed in glacial till.
ML, CL	Severe w,p,x	Severe w,x	Severe w,x	Severe w,x,f	Severe w,x,f	Severe w,x	Soil frequently flooded.
GM, ML	Severe r	Severe r,s	Severe r,s	Severe r,s	Severe r,s	Moderate to severe r,c,s	
ML, CL	Moderate to severe s,r	Moderate to severe s	Moderate s	Moderate s	Moderate s	Moderate to severe s	

ges.

SOIL CHARACTERISTICS AFFECTING LIMITATIONS

c poor workability; stony or clayey surface and subsoil
d droughty
f high frost heave potential
p slow permeability
r shallow to bedrock
s slope
u low strength or unstable soils
w seasonal wetness
x flooding hazard
z high shrink-swell potential

gh District, 1976

Table 2.1.3-2

INDUSTRIAL WASTE DISPOSAL SITES IN THE PENNSYLVANIA ORBES REGION

ALLEGHENY COUNTY

Indiana Township Land Reclamation Area - Cheswick Power Indiana Township (Permit issued 3/2/73)	W. A. Conwell, Vice Pres. Duquesne Light Co. 435 Fifth Ave. Pittsburgh, PA 15219
Springdale Power Station Ash & Disposal Area Frazer & Springdale Twps. (Permit issued 4/18/79)	West Penn Power Co. 800 Cabin Hill Drive Greensburg, PA 15601
Phillips Ash Disposal Area Crescent Township (Permit issued 7/8/75)	Duquesne Light Co. 435 Sixth Street Pittsburgh, PA 15219

ARMSTRONG COUNTY

Rochester & Pittsburgh Coal Co. Incin. Plum Creek Township (Permit issued 1/7/75)	Rochester & Pittsburgh Coal Co. Cherry Run Plant Elderton, PA 15736
Armstrong Fly Ash Site Washington Twp. (Permit issued 3/22/76)	West Penn Power Co. 800 Cabin Hill Drive Greensburg, PA 15601
Quaker State Fly Ash Disposal Site Honey Township (Permit issued 7/14/76)	Quaker State Oil Refining Corp. Emlenton Plant Emlenton, PA 16373
PA. Electric Co. - Keystone Plant Plum Creek Township (Permit issued 12/5/77)	Pennsylvania Electric Co. 1001 Broad Street Johnstown, PA 15907

BEAVER COUNTY

St. Joe Minerals Corp. Fly Ash Ldf. Potter Township (Permit issued 7/1/76)	St. Joe Minerals Corporation Zinc Smelting Division Monaca, PA 15061
Stabilized Sludge Disposal Site Greene Township (Permit issued 7/26/74)	Carl Labovitz Dravo Corp. Neville Island 4800 Grand Ave. Pittsburgh, PA 15225

Little Blue Run Div. Area Greene Twp. (Permit issued 11/25/75)	Pennsylvania Power Co. 1 East Washington St. New Castle, PA 16103
Cendrich Landfill Industry Boro (Permit issued 8/29/77)	George Cendrich Gen. Contracting, Inc. West Midland Ave. Midland, PA 15059
Peggs Run Development Area Greene Twp. (Permit issued 10/27/77)	Pennsylvania Power Co. 1 East Washington Street New Castle, PA 16103 c/o Ray E. Semmler, Pres.

BUTLER COUNTY

Winters Sludge Site Penn Township (Permit issued 9/10/75 Exp. 11/30/75)	E.H. Bilawich Construction, Inc. 19 Collins Ave. Lyndvia, PA 16045
National Underground Storage, Incin. Cherry Township (Permit issued 11/4/76)	National Underground Storage, Inc. Boyers, PA 16020

CLARION COUNTY

Glass Containers Corporation Knox Plant Incinerator Knox Boro (Permit issued 7/19/72)	J. B. Myers Project Engineer Glass Container Corp. Knox, PA 16232

CLEARFIELD COUNTY

Rockwell Plant #1 Incin. City of DuBois (Permit issued 1/18/74)	Roy Kiehl, Systems Engineer Rockwell International Corp. Liberty Boulevard DuBois, PA 15801

ELK COUNTY

Airco Speer Benzinger Township (Permit issued 3/24/78)	Thomas Gery Airco Speer 800 Theresia St. St. Marys, PA

Cycle Mix Building Landfill Benzinger Township	Stackpole Carbon Company St. Mary, PA 15857 Att: W. L. Donahey
Benzinger Twp. Area B Incinerator Benzinger Twp. (Permit issued 3/3/76)	Stackpole Carbon Co. Eschbach Road St. Marys, PA 15857
Industrial Waste Landfill Benzinger Twp.	Stackpole Carbon Co. St. Marys, PA 15857

GREENE COUNTY

Delworth Mine Incin. Cumberland Twp. (Permit issued 6/13/77)	U. S. Steel Corp. P. O. Box 26 Pittsburgh, PA 15230

MERCER COUNTY

Greenville Steel Car Company Incin. Greenville (Permit issued 7/27/76)	Greenville Steel Car Company Foot of Union Street Greenville, PA 16125

VENANGO COUNTY

Continental Can Co., Inc., Incin. Oil City (Permit issued 6/5/73)	Continental Can Co., Inc. 15 Mineral Street Oil City, PA 16301
Chicago Pneumatic Tool Co., Incin. Franklin (Permit issued 3/24/77)	Chicago Pneumatic Tool Co., Equip.Div. Howard Street Franklin, PA 16323

WASHINGTON COUNTY

Mitchell Power Station Ash Disposal Nottingham Township (Permit issued 12/9/74)	Mr. Benjamin Bennett West Penn Power Company 800 Cabin Hill Drive Greensburg, PA 15601
Elrama Fly Ash Disposal Area Union Township (Permit issued 1/16/75)	Duquesne Light Co. 435 Sixth Ave. Pittsburgh, PA 15219
Pitt Processing & Mfg. Co. Sludge Site Robinson Twp. (Permit issued 10/27/76)	Pitt Processing & Mfg. Co. 4314 Main Street Pittsburgh, PA 15224

Paris Fly Ash Site A Hanover Twp. (Permit issued 7/23/77)	Alex E. Paris Contracting Co., Inc. Route 18 Atlasburg, PA 15004

WESTMORELAND COUNTY

Gibson Electric Inc., Incin. Salem Township (Permit issued 6/12/74)	L. J. Maules, Vice-Pres. Gibson Electric, Inc. A Subsidiary of GTE Sylvania Old William Penn Highway Delmont, PA 15626
Wheeling-Pittsburgh Steel Slag Dump Rostraver Township (Permit issued 3/7/75) (Reissued 4/26/76)	W. P. Shane Wheeling-Pittsburgh Steel Corp. Duvall Center Wheeling, West Virginia 26003
Allegheny Ludlum Industrial Landfill Allegheny Township (Permit issued 7/27/78)	Allegheny Ludlum Steel Corp. River Road Brackenridge, PA 15014

TABLE 2.1.3.-3

SUMMARIZED CRITERIA AND STANDARDS FOR LAND DISPOSAL OF WASTES
(Pennsylvania Department of Environmental Resources
Published and Unpublished Sources)

	System Type	Depth to Bedrock	Depth to Water Table	Slope	Soil Permeability (Drainage)
Septic	Standard	6' minimum	6' minimum	0-15%	6-60 minutes/inch (1)
	Alternate	-	20 inches (2)	0-25%	- (3)
Spray Irrigation	1-1/2 inch/week	3'-5' minimum	3'-5' minimum	0-15%	Well to moderately well drained
Sludge	-	2' minimum	10' minimum	0-10%	Well to moderately well drained (4)

(1) Average percolation rate

(2) Depth to soil mottling

(3) Not utilized on floodplain soils, or somewhat poorly, poorly, and very poorly drained soils

(4) Moderately well drained with at least 24 inches to mottling; well drained with at least 36 inches to mottling; flooding frequency less than once in 25 years

From Pennsylvania DER, COWAMP report, Study Area 8, 1975

TABLE 2.1.3.-4 Area Covered by Soils Suitable for Land Disposal of Wastes

From Pennsylvania DER, COWAMP reports, Study Areas 8 and 9, 1975

	Type of Disposal			
	Land available for spray irrigation and sludge disposal		Land available for septic tank disposal (alt. and std. systems)	
County	%	sq. mi.	%	sq. mi.
Allegheny	1.3	8.6	31.7	206.1
Armstrong	2.7	19.6	51.6	376.4
Beaver	5.2	23.0	55.2	243.2
Butler	6.5	51.6	50.8	404.1
Clarion	5.4	32.6	43.7	263.5
Elk **	9.6	54.4	46.7	264.5
Fayette	5.2	29.7	23.2	133.3
Forest **	7.4	31.4	35.7	151.7
Greene	1.0	8.6	21.1	175.0
Indiana	6.2	51.4	50.2	417.0
Jefferson	5.9	38.3	45.9	297.7
Lawrence **	2.5	9.1	39.6	144.8
Mercer	0.4	2.5	28.6	195.6
Venango	2.7	18.5	40.0	274.0
Washington	0.1	0.7	25.5	218.7
Westmoreland	0.9	9.1	52.5	545.7
TOTALS	63.0	389.1	642.0	4,311.3

* Based on County Soil Conservation Service soil interpretation and Table 11, "Summarized Criteria for Land Disposal of Wastes"

** Soil series maps for county not completed. Percentages estimated from available maps obtained from SCS Offices.

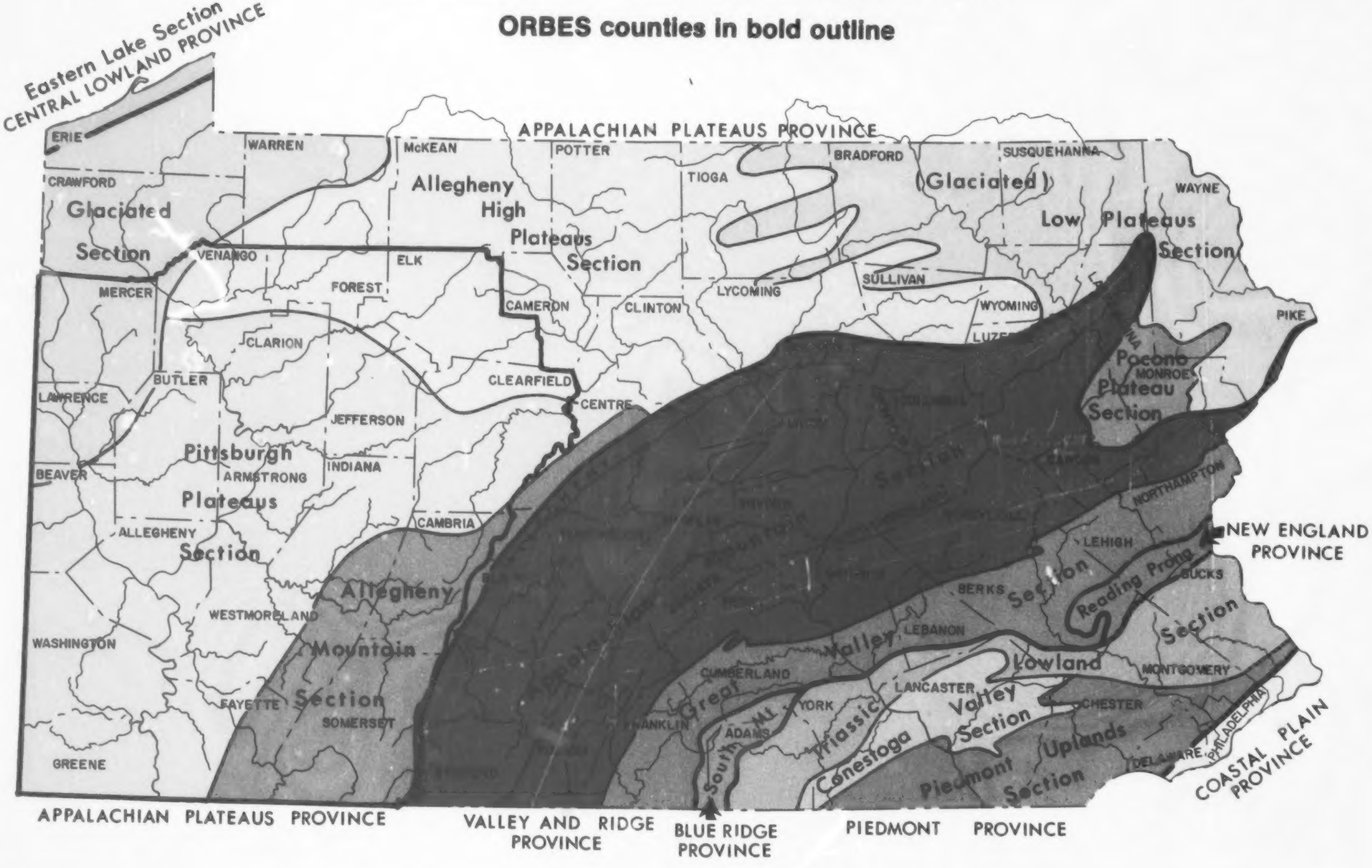
MAP 13

COMMONWEALTH OF PENNSYLVANIA
DEPARTMENT OF ENVIRONMENTAL RESOURCES
TOPOGRAPHIC AND GEOLOGIC SURVEY
Arthur A. Socolow, *State Geologist*

FIGURE 2.1.1. - 1

PHYSIOGRAPHIC PROVINCES OF PENNSYLVANIA

ORBES counties in bold outline


Eastern Lake Section
CENTRAL LOWLAND PROVINCE
APPALACHIAN PLATEAUS PROVINCE
ERIE
CRAWFORD
WARREN
McKEAN
POTTER
TIOGA
BRADFORD
SUSQUEHANNA
WAYNE
PIKE
Glaciated Section
VENANGO
MERCER
FOREST
ELK
CAMERON
CLINTON
LYCOMING
SULLIVAN
WYOMING
MONROE
Allegheny High Plateaus Section
(Glaciated) Low Plateaus Section
Pocono Plateau Section
CLARION
BUTLER
LAWRENCE
CLEARFIELD
CENTRE
JEFFERSON
BEAVER
ARMSTRONG
INDIANA
CAMBRIA
ALLEGHENY
Pittsburgh Plateaus Section
WESTMORELAND
WASHINGTON
FAYETTE
SOMERSET
GREENE
Allegheny Mountain Section
NORTHAMPTON
LEHIGH
BUCKS
BERKS
LEBANON
MONTGOMERY
CUMBERLAND
LANCASTER
YORK
ADAMS
FRANKLIN
CHESTER
DELAWARE
PHILADELPHIA
NEW ENGLAND PROVINCE
Reading Prong Section
Great Valley Section
Lowland Section
Triassic
South Mt.
Conestoga Valley Section
Piedmont Uplands Section
COASTAL PLAIN PROVINCE
APPALACHIAN PLATEAUS PROVINCE
VALLEY AND RIDGE PROVINCE
BLUE RIDGE PROVINCE
PIEDMONT PROVINCE

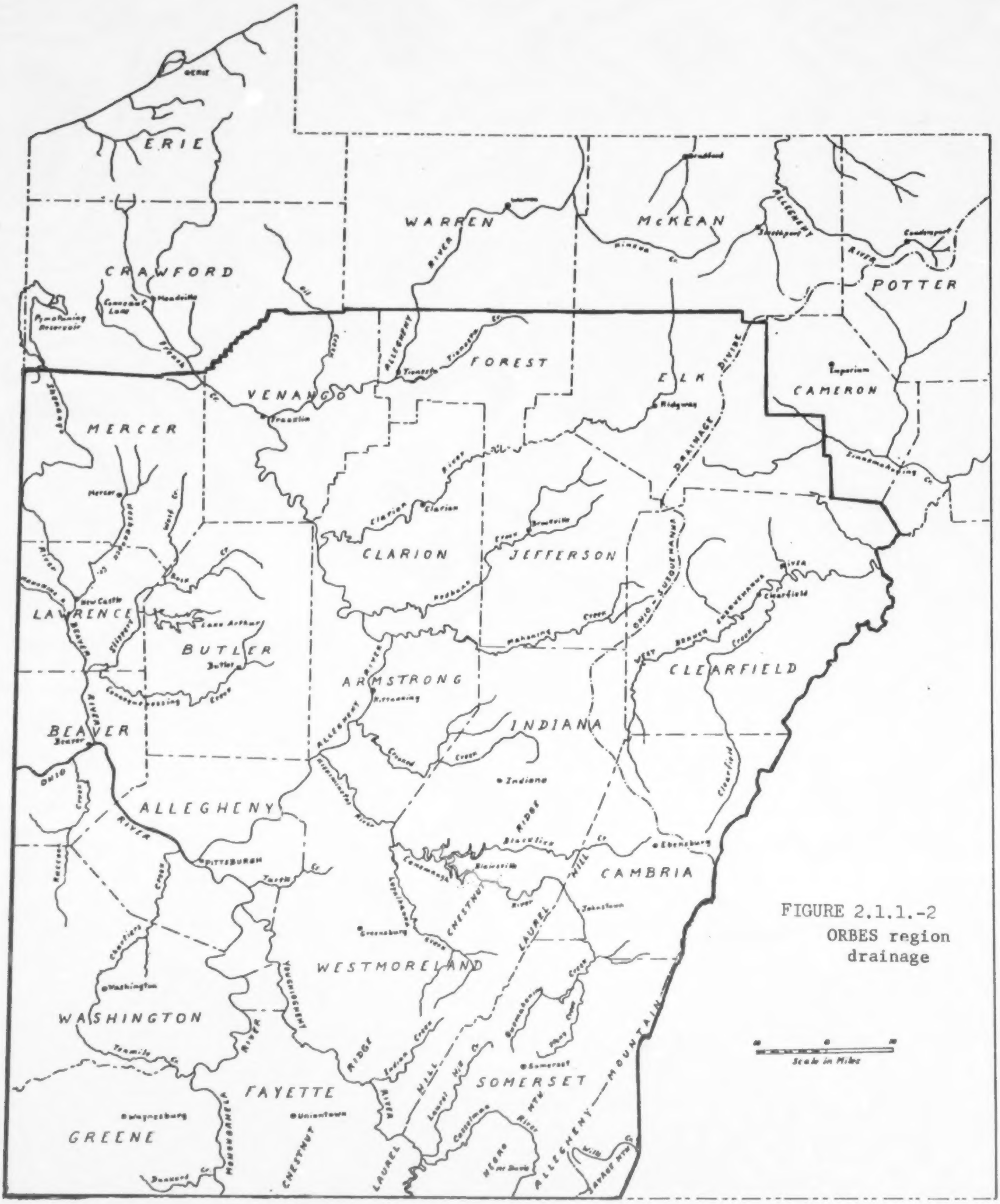

ERIE
CRAWFORD
WARREN
McKEAN
POTTER
CAMERON
ELK
FOREST
VENANGO
MERCER
CLARION
JEFFERSON
LAWRENCE
BUTLER
ARMSTRONG
CLEARFIELD
INDIANA
BEAVER
ALLEGHENY
CAMBRIA
WESTMORELAND
WASHINGTON
FAYETTE
SOMERSET
GREENE
Erie
Conneaut Lake
Meadville
Pymatuning Reservoir
French Cr.
Oil Cr.
Allegheny River
Tionesta Cr.
Tionesta
Franklin
Ridgway
Emporium
Bradford
Smethport
Coudersport
Allegheny River
Kinzua Cr.
Sinnemahoning Cr.
Divide
Drainage
Ohio - Susquehanna
Clarion River
Clarion
Brookville
Redbank Cr.
Mahoning Creek
Mercer
Shenango River
Neshannock Cr.
Wolf Cr.
New Castle
Slippery Rock Cr.
Lake Arthur
Butler
Connoquenessing Creek
Beaver River
Beaver
Kittanning
Crooked Cr.
Allegheny River
Kiskiminetas River
Indiana
Chestnut Ridge
Blacklick Cr.
Blairsville
Conemaugh River
Loyalhanna Creek
Ebensburg
Johnstown
Laurel Hill
West Branch Susquehanna River
Clearfield
Clearfield Cr.
Ohio River
Raccoon Cr.
Pittsburgh
Turtle Cr.
Chartiers Creek
Washington
Greensburg
Youghiogheny River
Monongahela River
Tenmile Cr.
Waynesburg
Dunkard Cr.
Uniontown
Chestnut Ridge
Laurel Hill
Indian Creek
Quemahoning Creek
Stony Creek
Somerset
Casselman River
Negro Mtn
Mt Davis
Allegheny Mountain
Savage Mtn
Wills Cr.
Scale in Miles

FIGURE 2.1.1.-2
ORBES region
drainage

GEOLOGIC MAP OF PENNSYLVANIA

COMMONWEALTH OF PENNSYLVANIA
DEPARTMENT OF ENVIRONMENTAL RESOURCES
TOPOGRAPHIC & GEOLOGIC SURVEY
Arthur A. Socolow, State Geologist

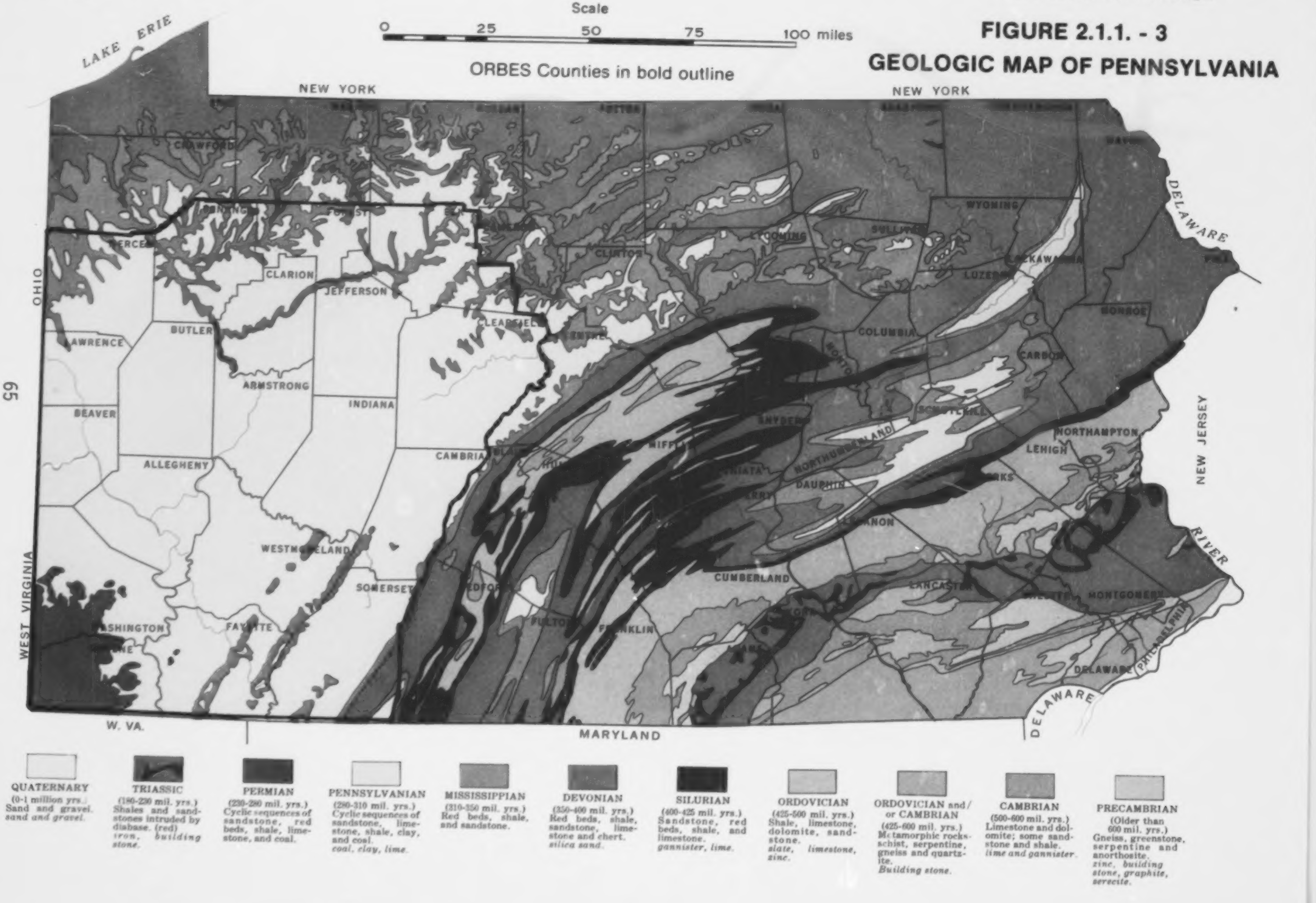

Scale
0
25
50
75
100 miles
ORBES Counties in bold outline
LAKE ERIE
NEW YORK
NEW YORK
OHIO
WEST VIRGINIA
W. VA.
MARYLAND
NEW JERSEY
DELAWARE
DELAWARE
RIVER
CRAWFORD
MERCER
CLARION
JEFFERSON
LAWRENCE
BUTLER
ARMSTRONG
INDIANA
BEAVER
ALLEGHENY
CAMBRIA
CLEARFIELD
CENTRE
CLINTON
LYCOMING
SULLIVAN
WYOMING
LACKAWANNA
LUZERNE
MONROE
CARBON
COLUMBIA
SCHUYLKILL
NORTHUMBERLAND
SNYDER
JUNIATA
DAUPHIN
LEBANON
NORTHAMPTON
LEHIGH
BERKS
CUMBERLAND
LANCASTER
CHESTER
MONTGOMERY
PHILADELPHIA
DELAWARE
WESTMORELAND
SOMERSET
BEDFORD
FULTON
FRANKLIN
FAYETTE
WASHINGTON
QUATERNARY
(0-1 million yrs.)
Sand and gravel.
sand and gravel.
TRIASSIC
(180-230 mil. yrs.)
Shales and sandstones intruded by diabase. (red)
iron, building stone.
PERMIAN
(230-280 mil. yrs.)
Cyclic sequences of sandstone, red beds, shale, limestone, and coal.
PENNSYLVANIAN
(280-310 mil. yrs.)
Cyclic sequences of sandstone, limestone, shale, clay, and coal.
coal, clay, lime.
MISSISSIPPIAN
(310-350 mil. yrs.)
Red beds, shale, and sandstone.
DEVONIAN
(350-400 mil. yrs.)
Red beds, shale, sandstone, limestone and chert.
silica sand.
SILURIAN
(400-425 mil. yrs.)
Sandstone, red beds, shale, and limestone.
gannister, lime.
ORDOVICIAN
(425-500 mil. yrs.)
Shale, limestone, dolomite, sandstone.
slate, limestone, zinc.
ORDOVICIAN and/or CAMBRIAN
(425-600 mil. yrs.)
Metamorphic rocks-schist, serpentine, gneiss and quartzite.
Building stone.
CAMBRIAN
(500-600 mil. yrs.)
Limestone and dolomite; some sandstone and shale.
lime and gannister.
PRECAMBRIAN
(Older than 600 mil. yrs.)
Gneiss, greenstone, serpentine and anorthosite.
zinc, building stone, graphite, serecite.

FIGURE 2.1.1. - 3
GEOLOGIC MAP OF PENNSYLVANIA

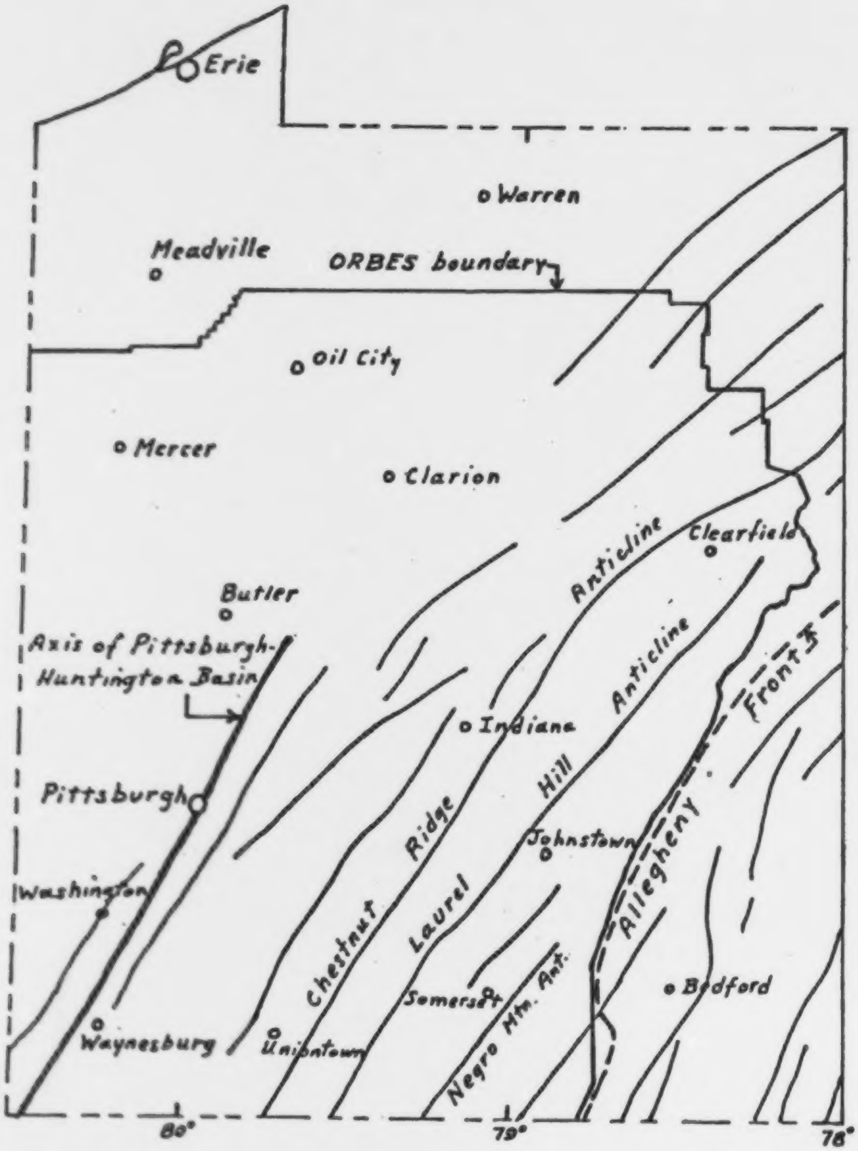

Erie
Warren
Meadville
ORBES boundary
Oil City
Mercer
Clarion
Clearfield
Butler
Anticline
Axis of Pittsburgh-Huntington Basin
Indiana
Anticline
Pittsburgh
Hill
Ridge
Johnstown
Allegheny
Front
Washington
Chestnut
Laurel
Somerset
Negro Mtn. Ant.
Bedford
Waynesburg
Uniontown
80°
79°
78°

FIGURE 2.1.1.-4

Axial trace of anticlinal structures in ORBES region

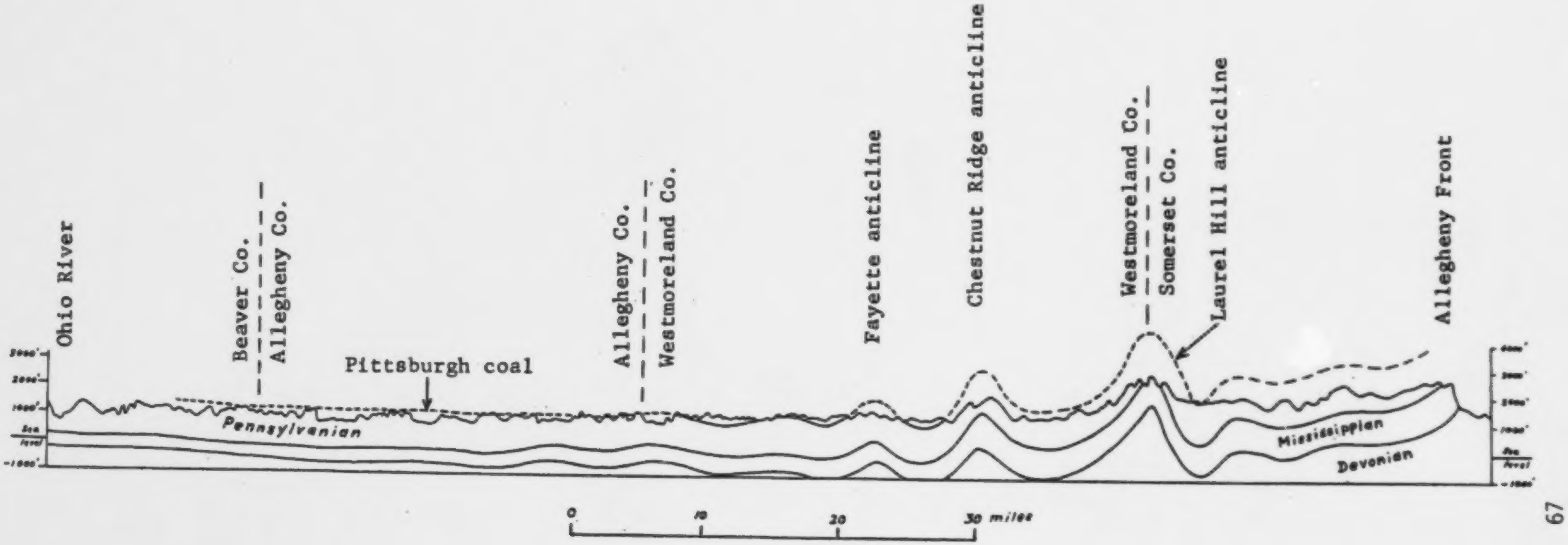

Ohio River
Beaver Co.
Allegheny Co.
Pittsburgh coal
Allegheny Co.
Westmoreland Co.
Fayette anticline
Chestnut Ridge anticline
Westmoreland Co.
Somerset Co.
Laurel Hill anticline
Allegheny Front
3000'
2000'
1000'
Sea level
-1000'
Pennsylvanian
Mississippian
Devonian
Sea level
0
10
20
30 miles

FIGURE 2.1.1.-5

Geologic structure section through Beaver, Allegheny, Westmoreland, and Somerset Counties from Ohio River to Allegheny Front

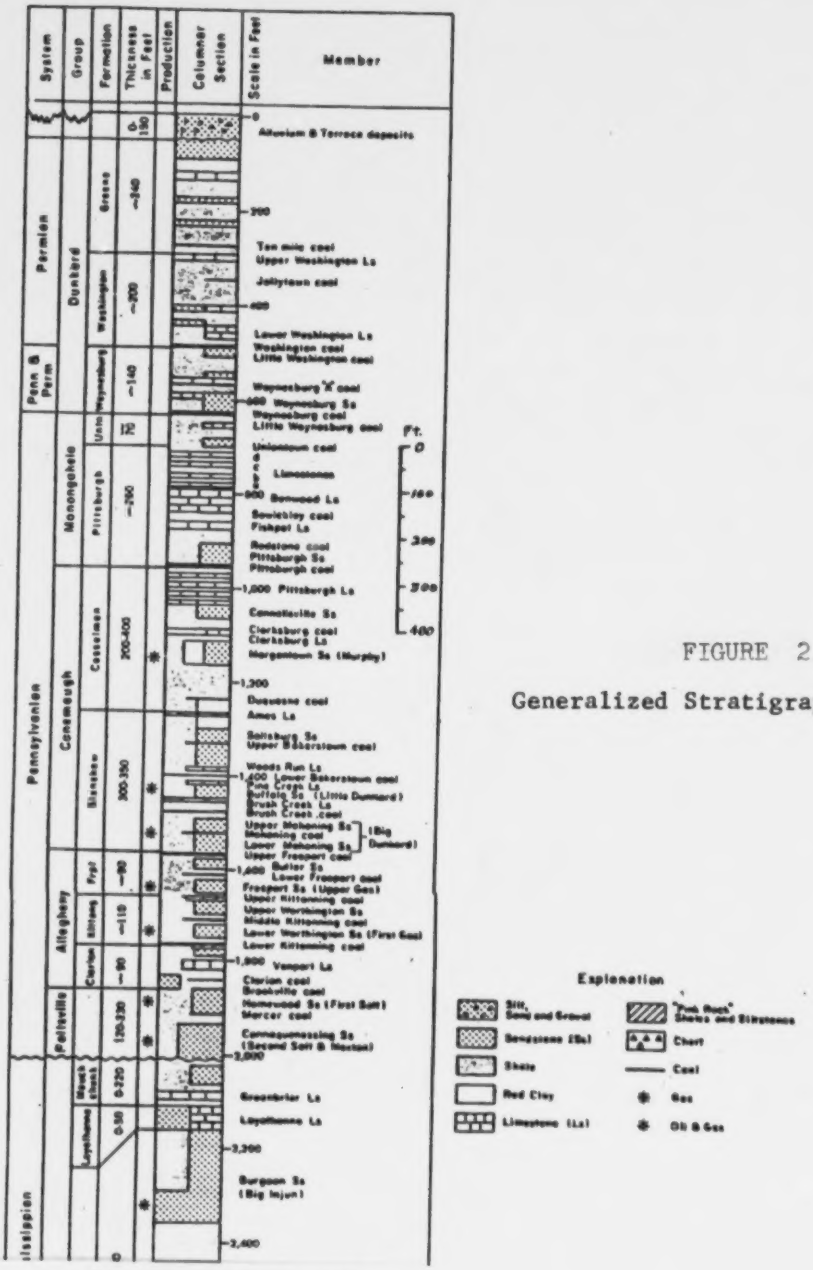

System
Group
Formation
Thickness in Feet
Production
Columnar Section
Scale in Feet
Member
Permian
Penn & Perm
Pennsylvanian
Dunkard
Monongahela
Conemaugh
Allegheny
Pottsville
Greene
Washington
Waynesburg
Unio
Pittsburgh
Casselman
Glenshaw
Frpt
Kittaning
Clarion
Mauch Chunk
Loyalhanna
0-150
~240
~200
~140
~290
200-400
300-350
~90
~110
~90
120-330
0-220
0-50
0
200
400
600
800
1,000
1,200
1,400
1,600
1,800
2,000
2,200
2,400
Alluvium & Terrace deposits
Ten mile coal
Upper Washington Ls
Jollytown coal
Lower Washington Ls
Washington coal
Little Washington coal
Waynesburg "A" coal
Waynesburg Ss
Waynesburg coal
Little Waynesburg coal
Uniontown coal
Limestones
Benwood Ls
Sewickley coal
Fishpot Ls
Redstone coal
Pittsburgh Ss
Pittsburgh coal
Pittsburgh Ls
Connellsville Ss
Clarksburg coal
Clarksburg Ls
Morgantown Ss (Murphy)
Duquesne coal
Ames Ls
Saltsburg Ss
Upper Bakerstown coal
Woods Run Ls
Lower Bakerstown coal
Pine Creek Ls
Buffalo Ss (Little Dunkard)
Brush Creek Ls
Brush Creek coal
Upper Mahoning Ss
Mahoning coal
Lower Mahoning Ss
(Big Dunkard)
Upper Freeport coal
Butler Ss
Lower Freeport coal
Freeport Ss (Upper Gas)
Upper Kittanning coal
Upper Worthington Ss
Middle Kittanning coal
Lower Worthington Ss (First Gas)
Lower Kittanning coal
Vanport Ls
Clarion coal
Brookville coal
Homewood Ss (First Salt)
Mercer coal
Connoquenessing Ss
(Second Salt & Neuton)
Greenbrier Ls
Loyalhanna Ls
Burgoon Ss
(Big Injun)
Ft.
0
100
200
300
400
Explanation
Silt, Sand and Gravel
Sandstone (Ss)
Shale
Red Clay
Limestone (Ls)
"Pink Rock" Shales and Siltstones
Chert
Coal
Gas
Oil & Gas

FIGURE 2.1.1.-6

Generalized Stratigraphic Section

Reproduced from
best available copy.

DISTRIBUTION OF PENNSYLVANIA COALS

COMMONWEALTH OF PENNSYLVANIA
DEPARTMENT OF ENVIRONMENTAL RESOURCES
TOPOGRAPHIC & GEOLOGIC SURVEY
Arthur A. Socolow, State Geologist

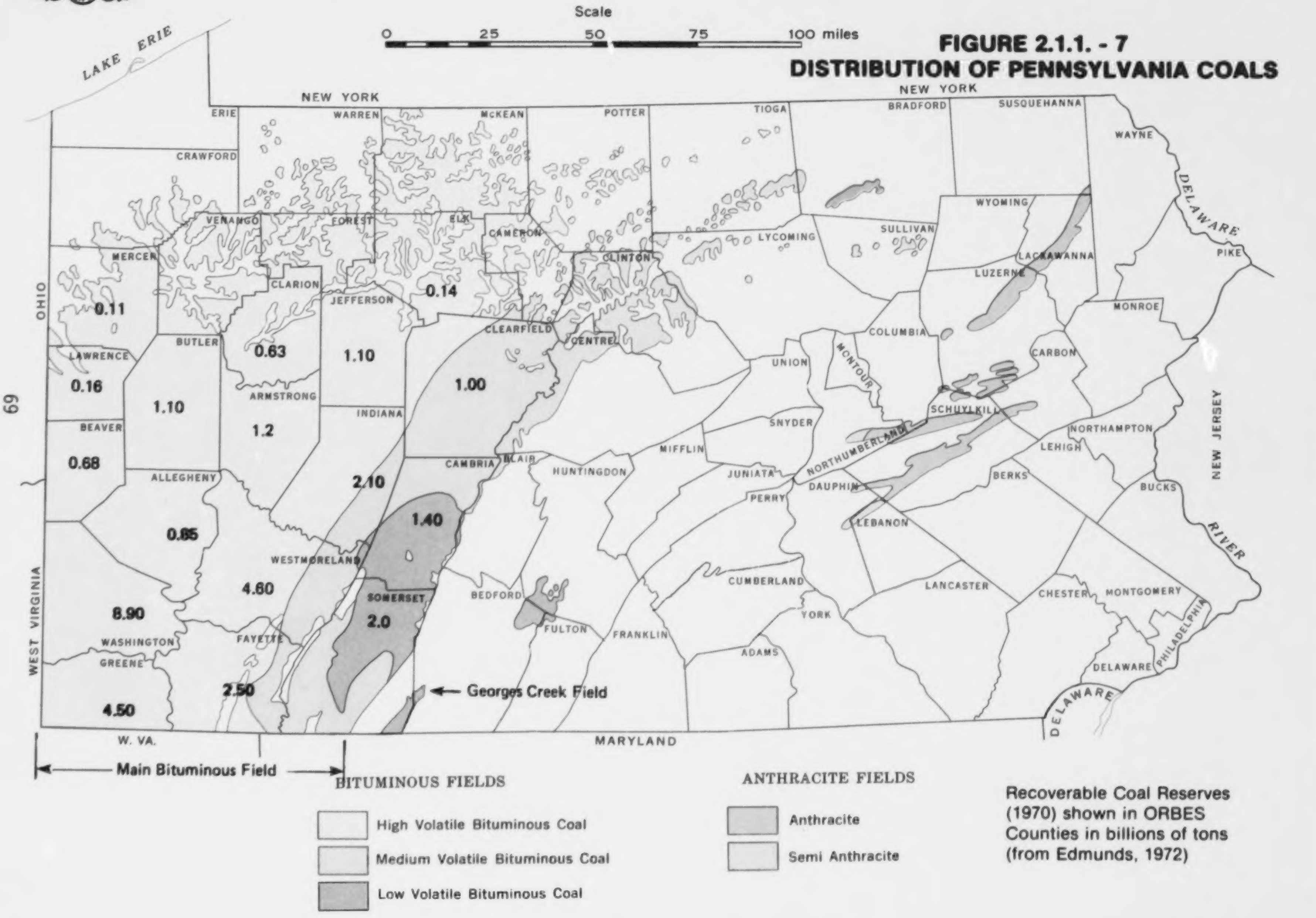
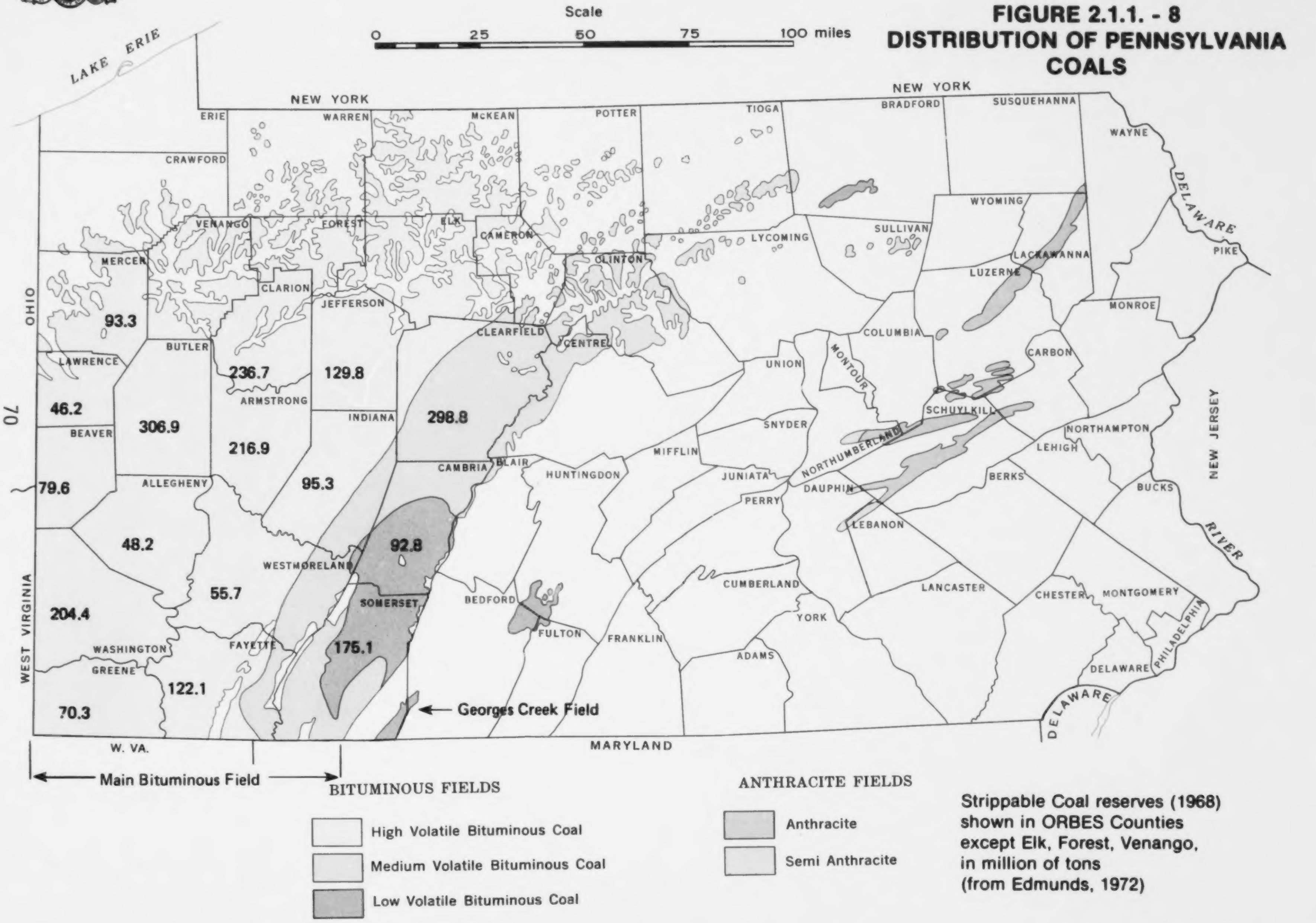

Scale
0
25
50
75
100 miles
LAKE ERIE
NEW YORK
OHIO
WEST VIRGINIA
W. VA.
MARYLAND
NEW JERSEY
DELAWARE
DELAWARE RIVER
ERIE
CRAWFORD
WARREN
McKEAN
POTTER
TIOGA
BRADFORD
SUSQUEHANNA
WAYNE
PIKE
VENANGO
FOREST
ELK
CAMERON
CLINTON
LYCOMING
SULLIVAN
WYOMING
LACKAWANNA
LUZERNE
MONROE
MERCER
CLARION
JEFFERSON
CLEARFIELD
CENTRE
UNION
MONTOUR
COLUMBIA
CARBON
SCHUYLKILL
NORTHAMPTON
LEHIGH
LAWRENCE
BUTLER
ARMSTRONG
INDIANA
CAMBRIA
BLAIR
HUNTINGDON
MIFFLIN
SNYDER
JUNIATA
PERRY
NORTHUMBERLAND
DAUPHIN
LEBANON
BERKS
BUCKS
BEAVER
ALLEGHENY
WESTMORELAND
SOMERSET
BEDFORD
FULTON
FRANKLIN
CUMBERLAND
YORK
ADAMS
LANCASTER
CHESTER
MONTGOMERY
DELAWARE
PHILADELPHIA
WASHINGTON
GREENE
FAYETTE
0.11
0.16
0.68
1.10
0.63
1.2
1.10
0.14
1.00
2.10
1.40
2.0
0.85
4.60
8.90
4.50
2.50
Georges Creek Field
Main Bituminous Field
BITUMINOUS FIELDS
High Volatile Bituminous Coal
Medium Volatile Bituminous Coal
Low Volatile Bituminous Coal
ANTHRACITE FIELDS
Anthracite
Semi Anthracite
Recoverable Coal Reserves
(1970) shown in ORBES
Counties in billions of tons
(from Edmunds, 1972)

FIGURE 2.1.1. - 7
DISTRIBUTION OF PENNSYLVANIA COALS

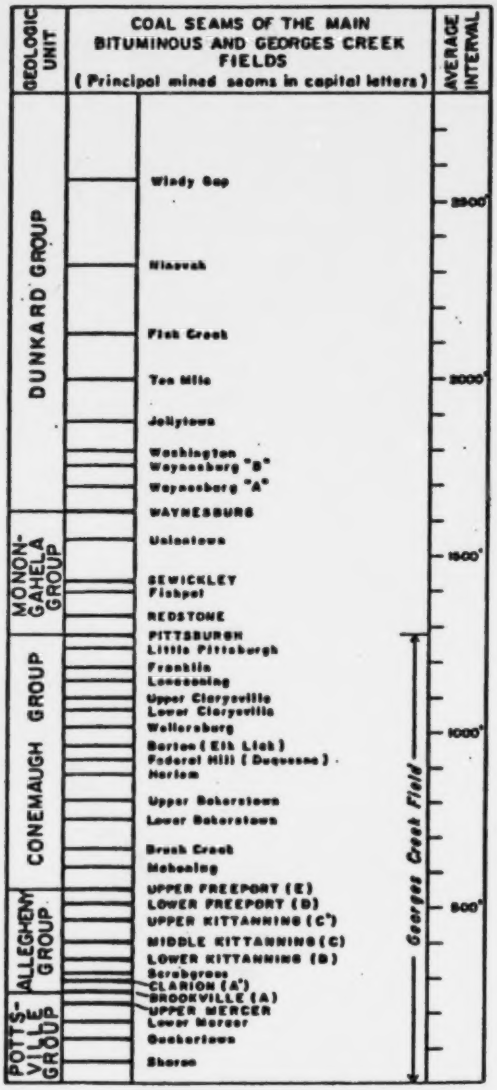
DISTRIBUTION OF PENNSYLVANIA COALS

COMMONWEALTH OF PENNSYLVANIA
DEPARTMENT OF ENVIRONMENTAL RESOURCES
TOPOGRAPHIC & GEOLOGIC SURVEY
Arthur A. Socolow, State Geologist


Scale
0
25
50
75
100 miles
LAKE ERIE
NEW YORK
NEW YORK
OHIO
WEST VIRGINIA
W. VA.
MARYLAND
NEW JERSEY
DELAWARE
DELAWARE RIVER
DELAWARE
ERIE
CRAWFORD
WARREN
MCKEAN
POTTER
TIOGA
BRADFORD
SUSQUEHANNA
WAYNE
VENANGO
FOREST
ELK
CAMERON
CLINTON
LYCOMING
SULLIVAN
WYOMING
LACKAWANNA
LUZERNE
PIKE
MERCER
93.3
CLARION
JEFFERSON
CLEARFIELD
CENTRE
COLUMBIA
MONTOUR
MONROE
CARBON
LAWRENCE
BUTLER
236.7
129.8
UNION
46.2
ARMSTRONG
INDIANA
298.8
SNYDER
SCHUYLKILL
NORTHAMPTON
BEAVER
306.9
216.9
MIFFLIN
NORTHUMBERLAND
LEHIGH
79.6
ALLEGHENY
95.3
CAMBRIA
BLAIR
HUNTINGDON
JUNIATA
DAUPHIN
BERKS
BUCKS
PERRY
LEBANON
48.2
WESTMORELAND
92.8
55.7
CUMBERLAND
LANCASTER
CHESTER
MONTGOMERY
204.4
SOMERSET
BEDFORD
YORK
PHILADELPHIA
WASHINGTON
FAYETTE
175.1
FULTON
FRANKLIN
ADAMS
DELAWARE
GREENE
122.1
70.3
Georges Creek Field
Main Bituminous Field
BITUMINOUS FIELDS
High Volatile Bituminous Coal
Medium Volatile Bituminous Coal
Low Volatile Bituminous Coal
ANTHRACITE FIELDS
Anthracite
Semi Anthracite

Strippable Coal reserves (1968)
shown in ORBES Counties
except Elk, Forest, Venango,
in million of tons
(from Edmunds, 1972)

FIGURE 2.1.1. - 8
DISTRIBUTION OF PENNSYLVANIA
COALS


GEOLOGIC UNIT
COAL SEAMS OF THE MAIN BITUMINOUS AND GEORGES CREEK FIELDS
(Principal mined seams in capital letters)
AVERAGE INTERVAL
DUNKARD GROUP
MONONGAHELA GROUP
CONEMAUGH GROUP
ALLEGHENY GROUP
POTTSVILLE GROUP
Windy Gap
Nineveh
Fish Creek
Ten Mile
Jollytown
Washington
Waynesburg "B"
Waynesburg "A"
WAYNESBURG
Uniontown
SEWICKLEY
Fishpot
REDSTONE
PITTSBURGH
Little Pittsburgh
Franklin
Lonaconing
Upper Clarysville
Lower Clarysville
Wellersburg
Barton (Elk Lick)
Federal Hill (Duquesne)
Harlem
Upper Bakerstown
Lower Bakerstown
Brush Creek
Mahoning
UPPER FREEPORT (E)
LOWER FREEPORT (D)
UPPER KITTANNING (C')
MIDDLE KITTANNING (C)
LOWER KITTANNING (B)
Scrubgrass
CLARION (A')
BROOKVILLE (A)
UPPER MERCER
Lower Mercer
Quakertown
Sharon
Georges Creek Field
2500'
2000'
1500'
1000'
500'

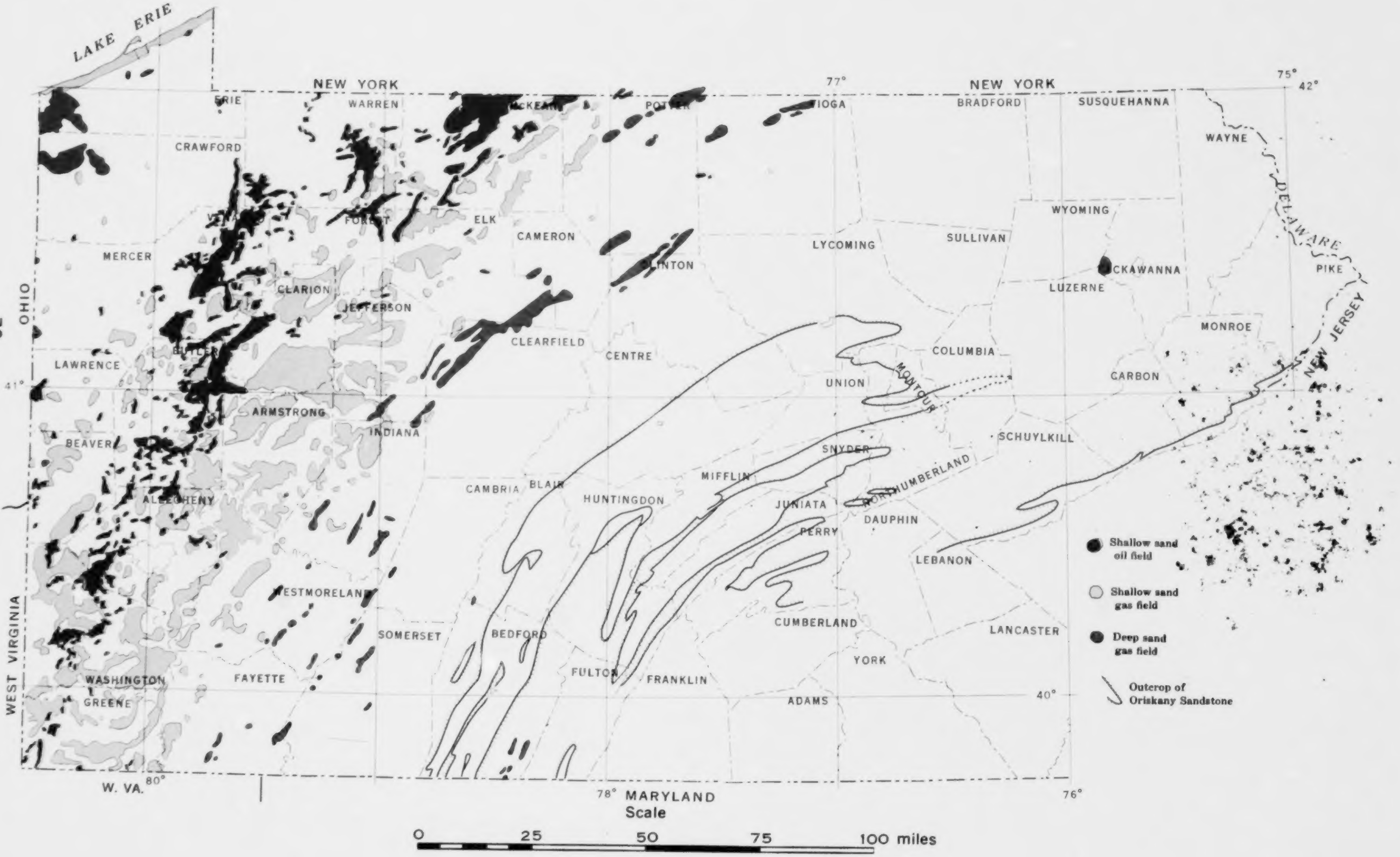
Coal seams of the Main Bituminous and Georges Creek Fields.

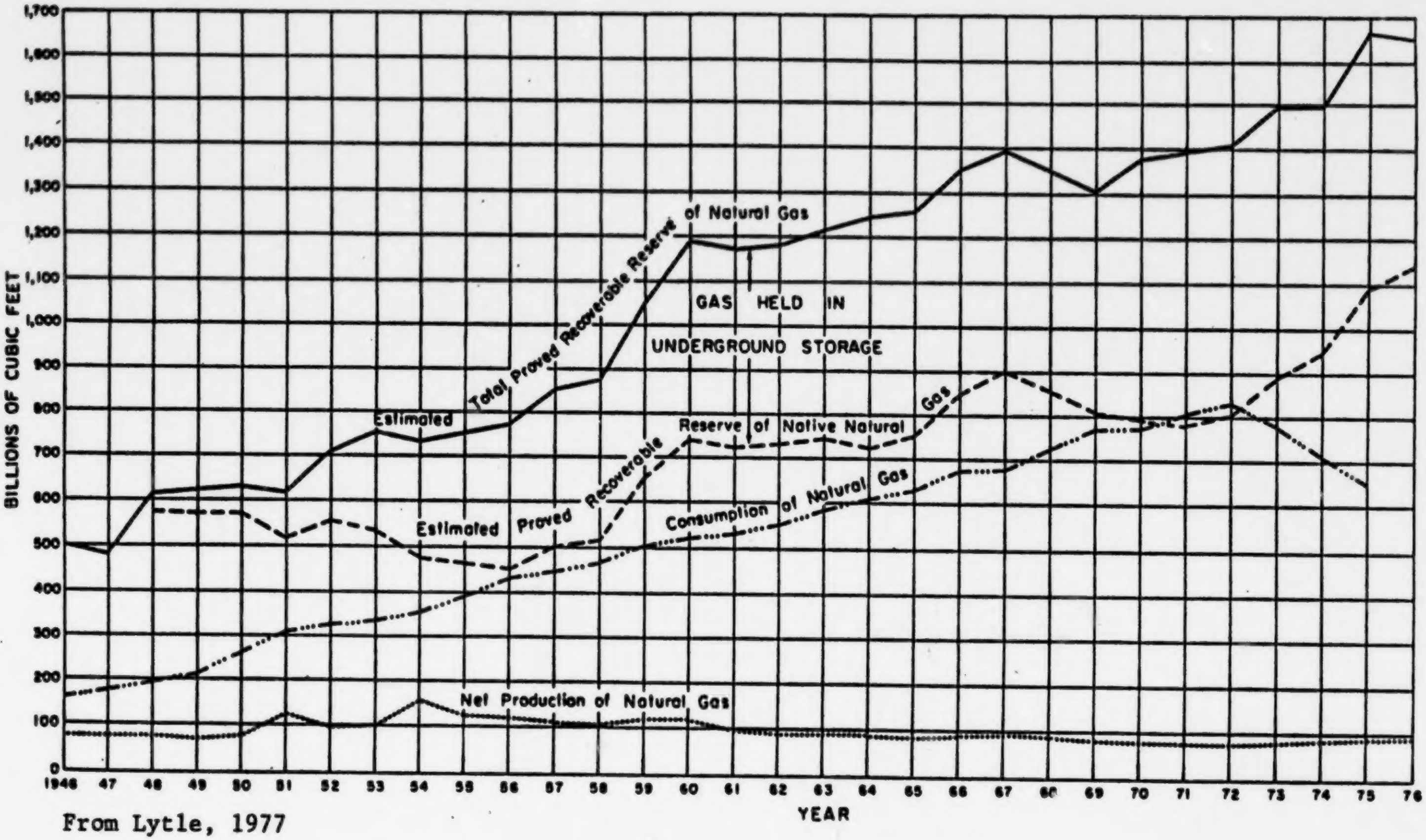
From Edmunds, 1972

FIGURE 2.1.1.-9

FIGURE 2.1.1. - 10
OIL AND GAS FIELDS MAP OF PENNSYLVANIA

COMMONWEALTH OF PENNSYLVANIA
DEPARTMENT OF ENVIRONMENTAL RESOURCES
TOPOGRAPHIC & GEOLOGIC SURVEY
Arthur A. Socolow, State Geologist


LAKE ERIE
NEW YORK
NEW YORK
OHIO
WEST VIRGINIA
W. VA.
MARYLAND
NEW JERSEY
DELAWARE
77°
75°
42°
41°
80°
78°
76°
40°
ERIE
CRAWFORD
WARREN
MCKEAN
POTTER
TIOGA
BRADFORD
SUSQUEHANNA
WAYNE
PIKE
MERCER
VENANGO
FOREST
ELK
CAMERON
CLINTON
LYCOMING
SULLIVAN
WYOMING
LACKAWANNA
LUZERNE
MONROE
CARBON
LAWRENCE
BUTLER
CLARION
JEFFERSON
CLEARFIELD
CENTRE
UNION
MONTOUR
COLUMBIA
SCHUYLKILL
BEAVER
ARMSTRONG
INDIANA
SNYDER
NORTHUMBERLAND
MIFFLIN
JUNIATA
DAUPHIN
PERRY
LEBANON
CAMBRIA
BLAIR
HUNTINGDON
ALLEGHENY
WESTMORELAND
SOMERSET
BEDFORD
FULTON
FRANKLIN
CUMBERLAND
YORK
ADAMS
LANCASTER
WASHINGTON
GREENE
FAYETTE
Shallow sand oil field
Shallow sand gas field
Deep sand gas field
Outcrop of Oriskany Sandstone
Scale
0
25
50
75
100 miles



From Lytle, 1977

FIGURE 2.1.1.-12 Production, consumption, and reserves of natural gas in Pennsylvania

MAP 15

LIMESTONE AND DOLOMITE DISTRIBUTION IN PENNSYLVANIA

COMMONWEALTH OF PENNSYLVANIA
DEPARTMENT OF ENVIRONMENTAL RESOURCES
TOPOGRAPHIC AND GEOLOGIC SURVEY
ARTHUR A. SOCOLOW, *State Geologist*

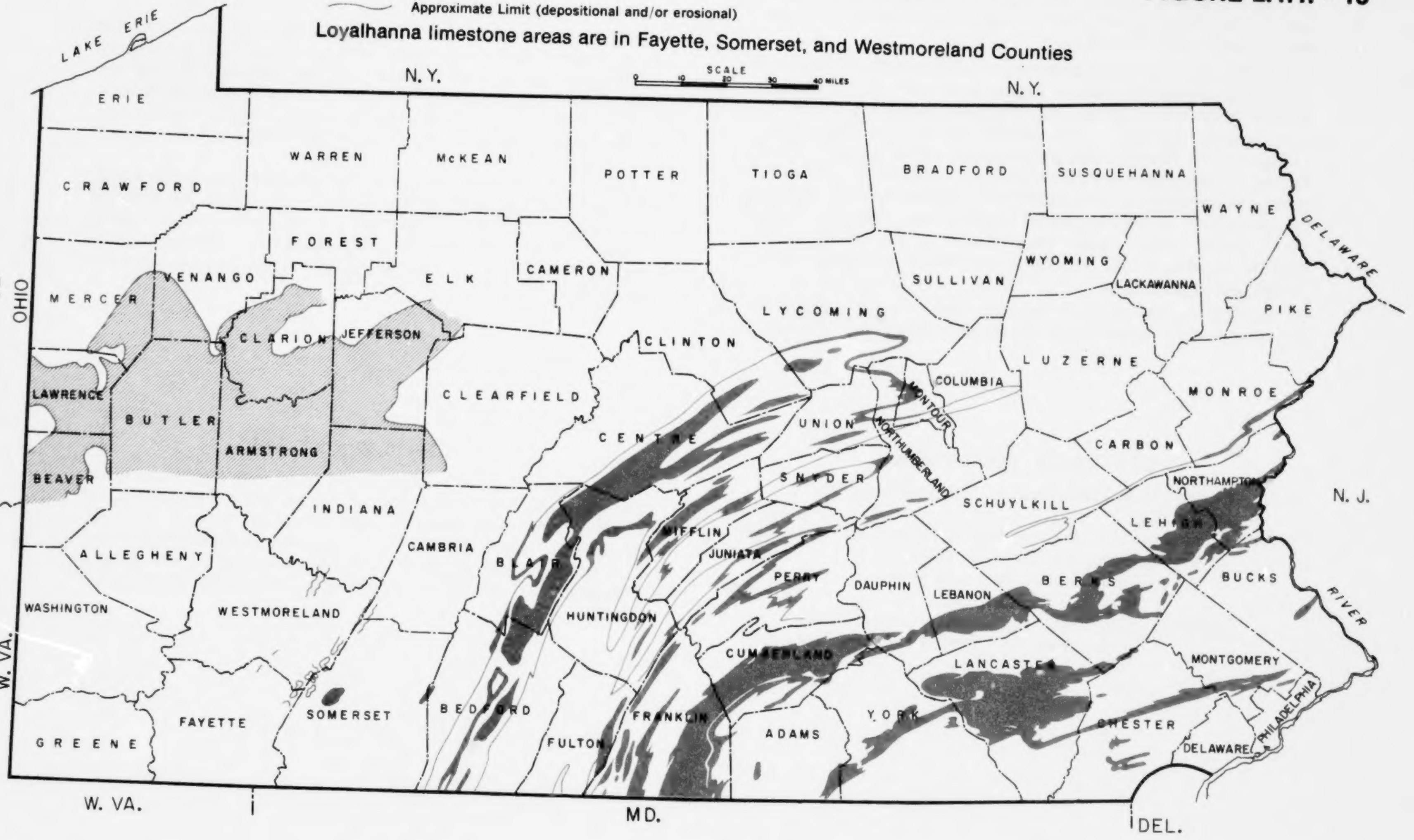
FIGURE 2.1.1. - 13

▨ SURFACE AND SUBSURFACE (Vanport Ls.)

■ SURFACE ONLY

Approximate Limit (depositional and/or erosional)

Loyalhanna limestone areas are in Fayette, Somerset, and Westmoreland Counties


LAKE ERIE
SCALE
0 10 20 30 40 MILES
N. Y.
N. Y.
ERIE
CRAWFORD
WARREN
McKEAN
POTTER
TIOGA
BRADFORD
SUSQUEHANNA
WAYNE
DELAWARE
PIKE
FOREST
MERCER
VENANGO
ELK
CAMERON
SULLIVAN
WYOMING
LACKAWANNA
LYCOMING
CLARION
JEFFERSON
CLINTON
LUZERNE
MONROE
COLUMBIA
MONTOUR
LAWRENCE
BUTLER
CLEARFIELD
CENTRE
UNION
NORTHUMBERLAND
CARBON
ARMSTRONG
BEAVER
SNYDER
NORTHAMPTON
SCHUYLKILL
N. J.
INDIANA
MIFFLIN
LEHIGH
CAMBRIA
BLAIR
JUNIATA
PERRY
DAUPHIN
LEBANON
BERKS
BUCKS
ALLEGHENY
WASHINGTON
WESTMORELAND
HUNTINGDON
RIVER
CUMBERLAND
LANCASTER
MONTGOMERY
SOMERSET
BEDFORD
FRANKLIN
YORK
CHESTER
PHILADELPHIA
FAYETTE
GREENE
FULTON
ADAMS
DELAWARE
OHIO
W. VA.
W. VA.
MD.
DEL.

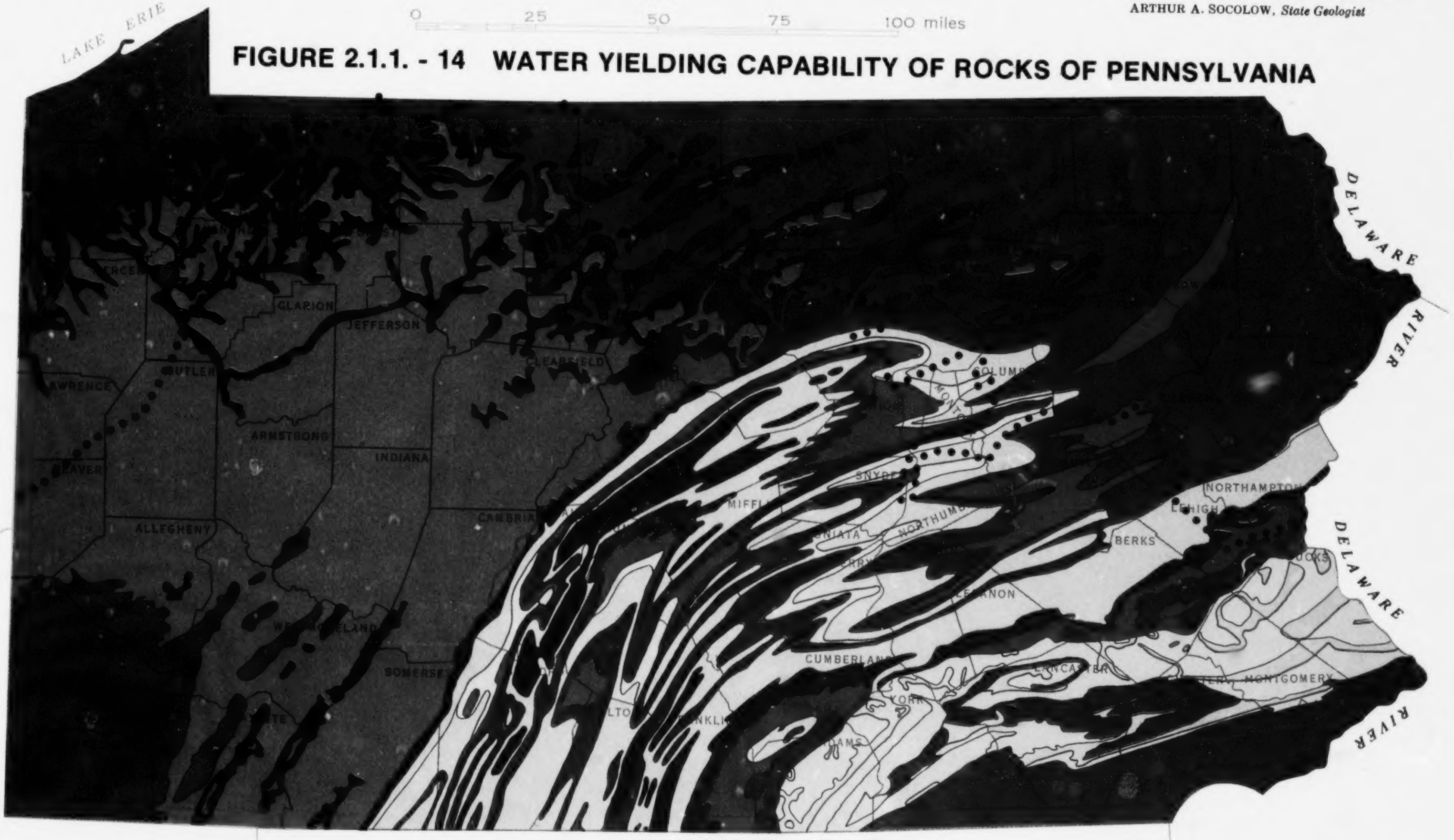
WATER YIELDING CAPABILITY OF ROCKS OF PENNSYLVANIA

COMMONWEALTH OF PENNSYLVANIA
DEPARTMENT OF ENVIRONMENTAL RESOURCES
TOPOGRAPHIC AND GEOLOGIC SURVEY
ARTHUR A. SOCOLOW, *State Geologist*

Scale

0 25 50 75 100 miles

FIGURE 2.1.1. - 14 WATER YIELDING CAPABILITY OF ROCKS OF PENNSYLVANIA


LAKE ERIE
DELAWARE RIVER
DELAWARE RIVER
MERCER
CLARION
JEFFERSON
CLEARFIELD
BUTLER
LAWRENCE
ARMSTRONG
INDIANA
BEAVER
ALLEGHENY
CAMBRIA
WESTMORELAND
SOMERSET
COLUMBIA
MONTOUR
SNYDER
MIFFLIN
JUNIATA
NORTHUMBERLAND
PERRY
NORTHAMPTON
LEHIGH
BERKS
BUCKS
LEBANON
CUMBERLAND
LANCASTER
YORK
ADAMS
MONTGOMERY

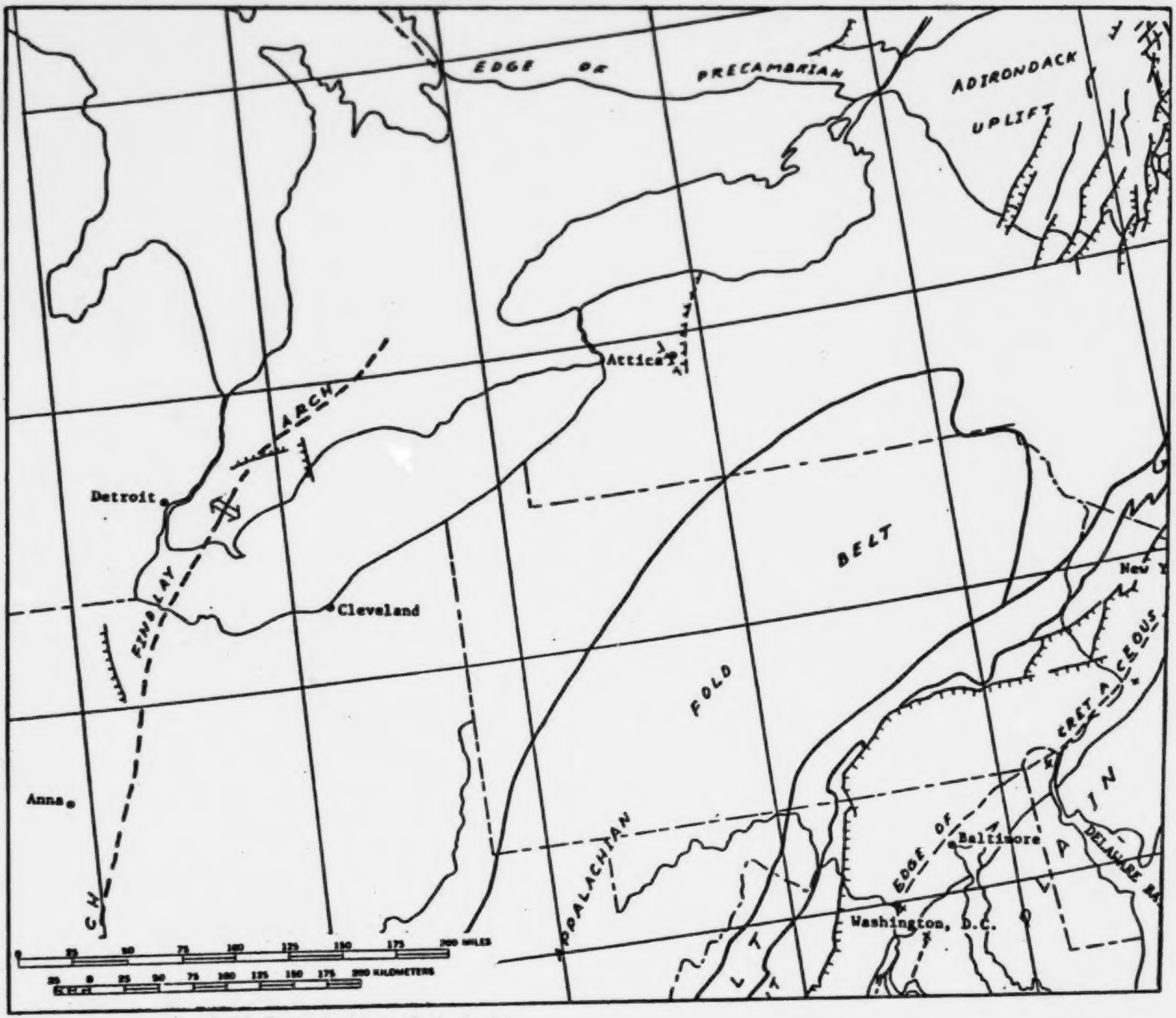
ESTIMATED MEDIAN YIELD (gpm) OF BEDROCK UNITS

▨	■	▨	■	■
10 to 25	26 to 50	51 to 100	101 to 200	201 to 850

•••••••• Southern limit of glacial deposits

Median yield is the yield in the middle of the range of yields of a rock formation. Each of the five colors on the map includes several formations, each with its own median yield figure. The range given for each color is from the formation with the highest median yield.

Yields of wells in glacial and stream deposits of sand and gravel range from 20 to 2000 gpm.


EDGE OF PRECAMBRIAN
ADIRONDACK UPLIFT
Attica
FINDLAY ARCH
Detroit
Cleveland
Anna
CH
BELT
FOLD
APPALACHIAN
New Y
CRETACEOUS
EDGE OF
Baltimore
PLAIN
DELAWARE BA
Washington, D.C.
0 25 50 75 100 125 150 175 200 MILES
25 0 25 50 75 100 125 150 175 200 KILOMETERS

EXPLANATION

From Hadley and Devine, 1974

Geologic boundary

Tectonic province boundary
Dashed where concealed by younger deposits

Major anticline or anticlinorium

Major syncline or synclinorium

Arch
Showing approximate location of axis

Dome

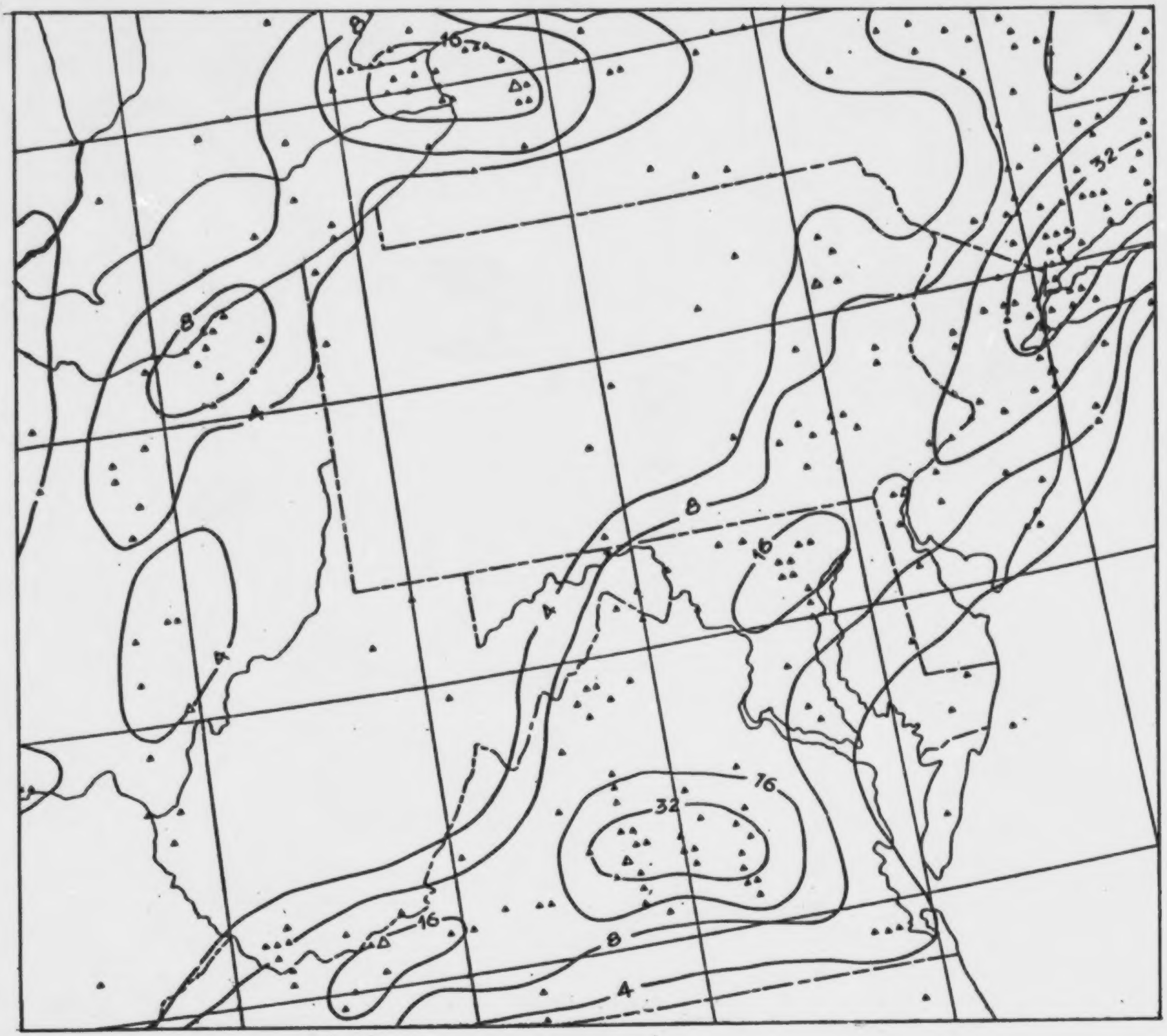
High-angle fault
Hachures on downthrown side where known; arrows show relative movement.
Dashed where approximately located or covered by younger deposits

Low-angle fault
Sawteeth on upper plate. Dashed where covered by younger deposits

Axis of embayment trough

×
Locally observed folds or faults in Coastal Plain rocks

FIGURE 2.1.1.-15
Tectonic Map



EXPLANATION

The center of each triangular symbol indicates the epicentral location of one or more seismic events, plotted to the nearest 0.1 degree of latitude and longitude. The intensity shown is maximum Modified Mercalli (MM) intensity in the epicentral area of the largest event at the plotted location. Most locations are based on observations of intensity rather than on instrumental records

——8——

Seismic frequency contour represents the areal distribution of earthquake epicenters with epicentral intensity of MM III and greater, as indicated by the total number per $10^4 km^2$ during the period 1800-1972. Contour intervals are 0-4, more than 4 but less than 8, more than 8 but less than 16, more than 16 but less than 32, more than 32 but less than 64, and more than 64. The contours are considerably generalized and are shown only as a guide for estimating regional seismicity. They have no value for precise location of seismic boundaries

Modified Mercalli Intensity

▴ III to VI

△ VII

△ VIII

△ IX-X

△ XII

25 0 25 50 75 100 125 150 175 200 MILES
25 0 25 50 75 100 125 150 175 200 KILOMETERS

From Hadley and Devine
1974

FIGURE 2.1.1.-16

Earthquake epicenters, 1800-1972

From King and Zietz, 1978

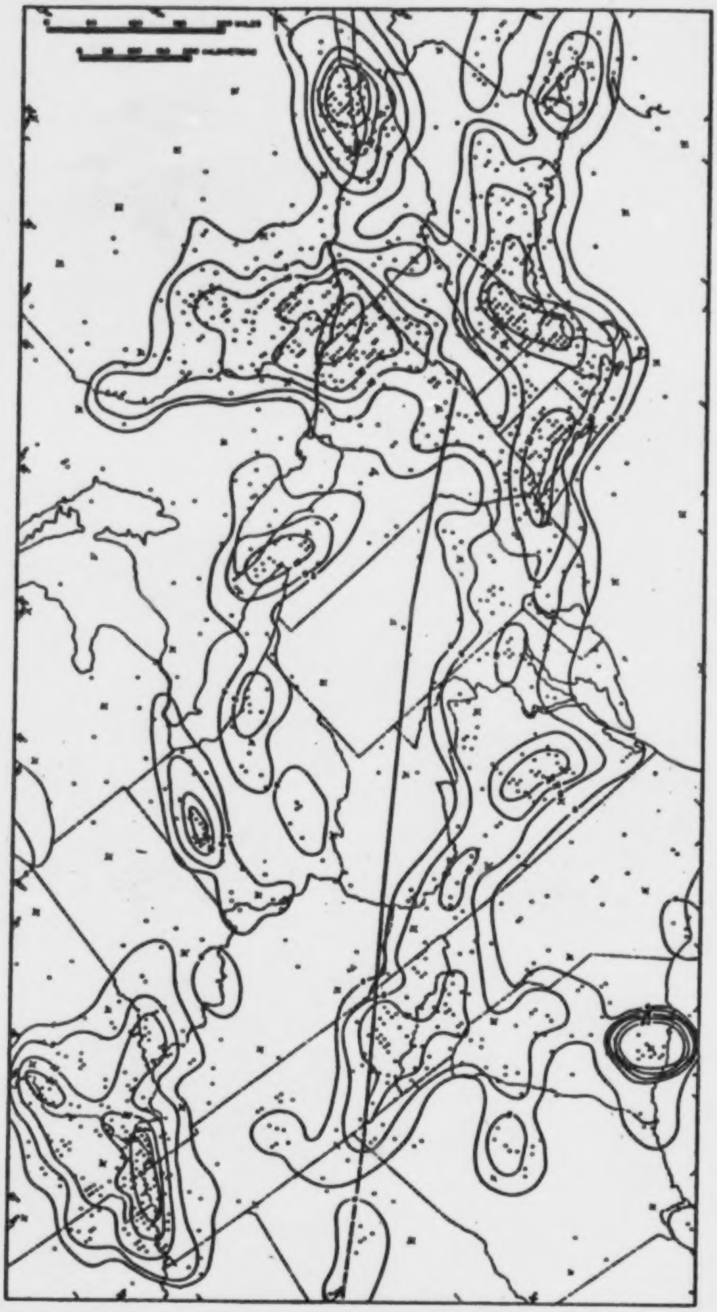


FIGURE 2.1.1.-17

New York - Alabama lineament plotted on seismotectonic map of eastern United States (Hadley and Devine, 1974) showing earthquake epicenters of modified Mercalli III or greater, recorded from 1800 to 1972. Contours show number of epicenters per 10,000 km.^{2}. Location of lineament is based on magnetic and gravity data.

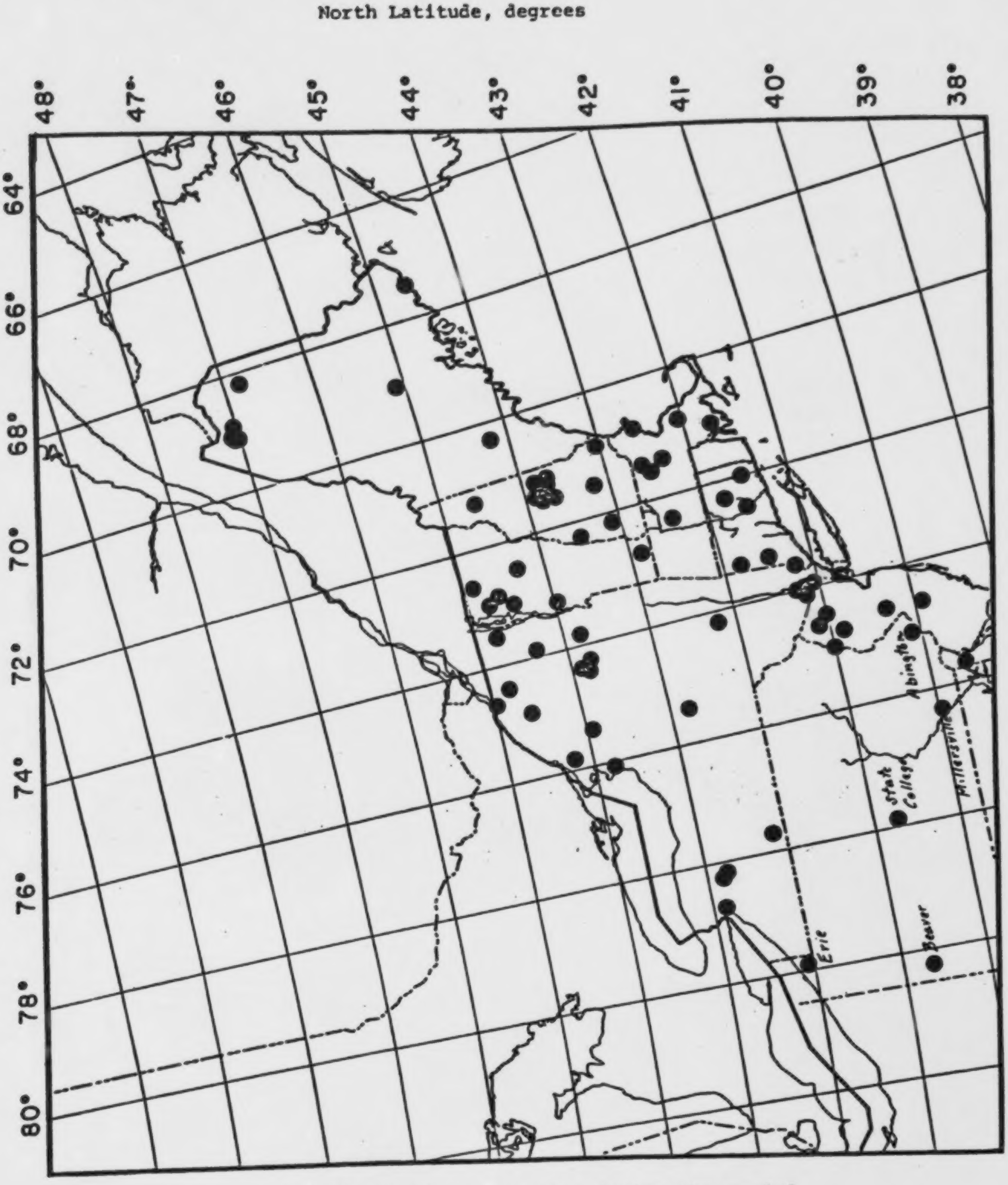
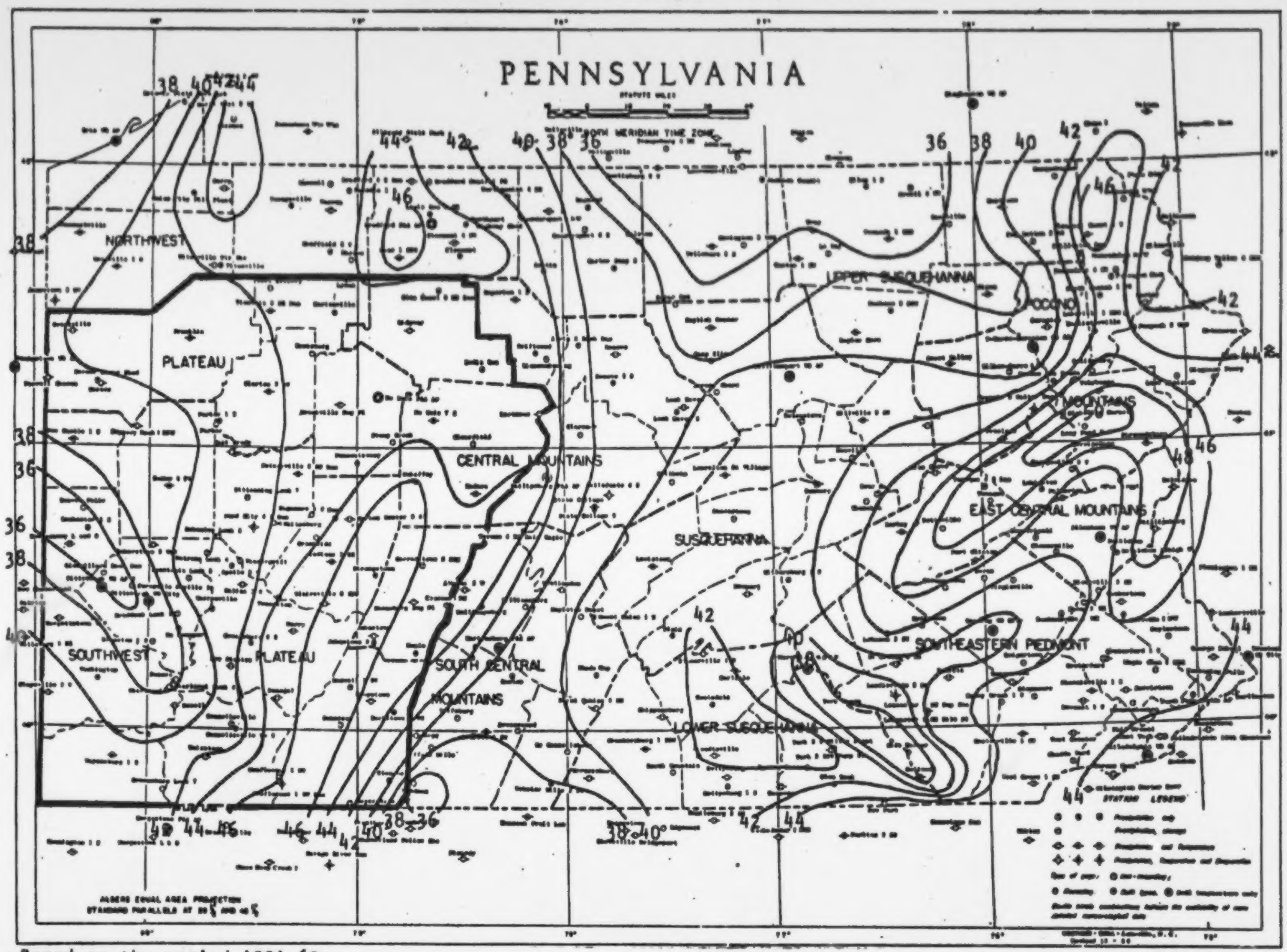

North Latitude, degrees
48°
47°
46°
45°
44°
43°
42°
41°
40°
39°
38°
64°
66°
68°
70°
72°
74°
76°
78°
80°
Abington
Millersville
State College
Erie
Beaver

FIGURE 2.1.1.-18 Seismic stations operating during the period July - September 1977

Mean Annual Precipitation, Inches


PENNSYLVANIA
CENTRAL MOUNTAINS
NORTHWEST
PLATEAU
SOUTHWEST
PLATEAU
SOUTH CENTRAL
MOUNTAINS
UPPER SUSQUEHANNA
POCONO
MOUNTAINS
SUSQUEHANNA
EAST CENTRAL MOUNTAINS
SOUTHEASTERN PIEDMONT
LOWER SUSQUEHANNA
38
40
42
44
46
48
50
36
ALBERS EQUAL AREA PROJECTION
STATION LEGEND

Based on the period 1931-60

ORBES region in bold outline

Figure 2,1.2.-1

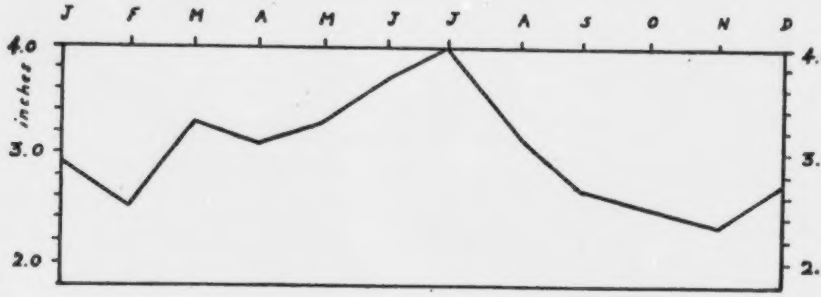


Figure 2.1.2.-2 **Mean monthly precipitation at Pittsburgh**

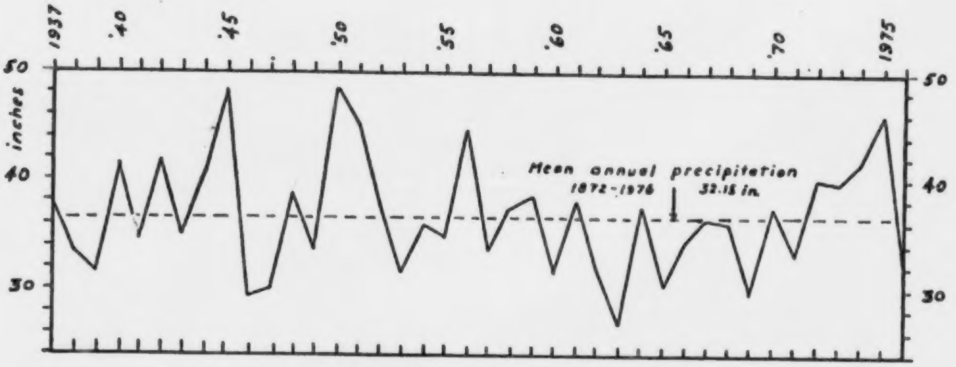
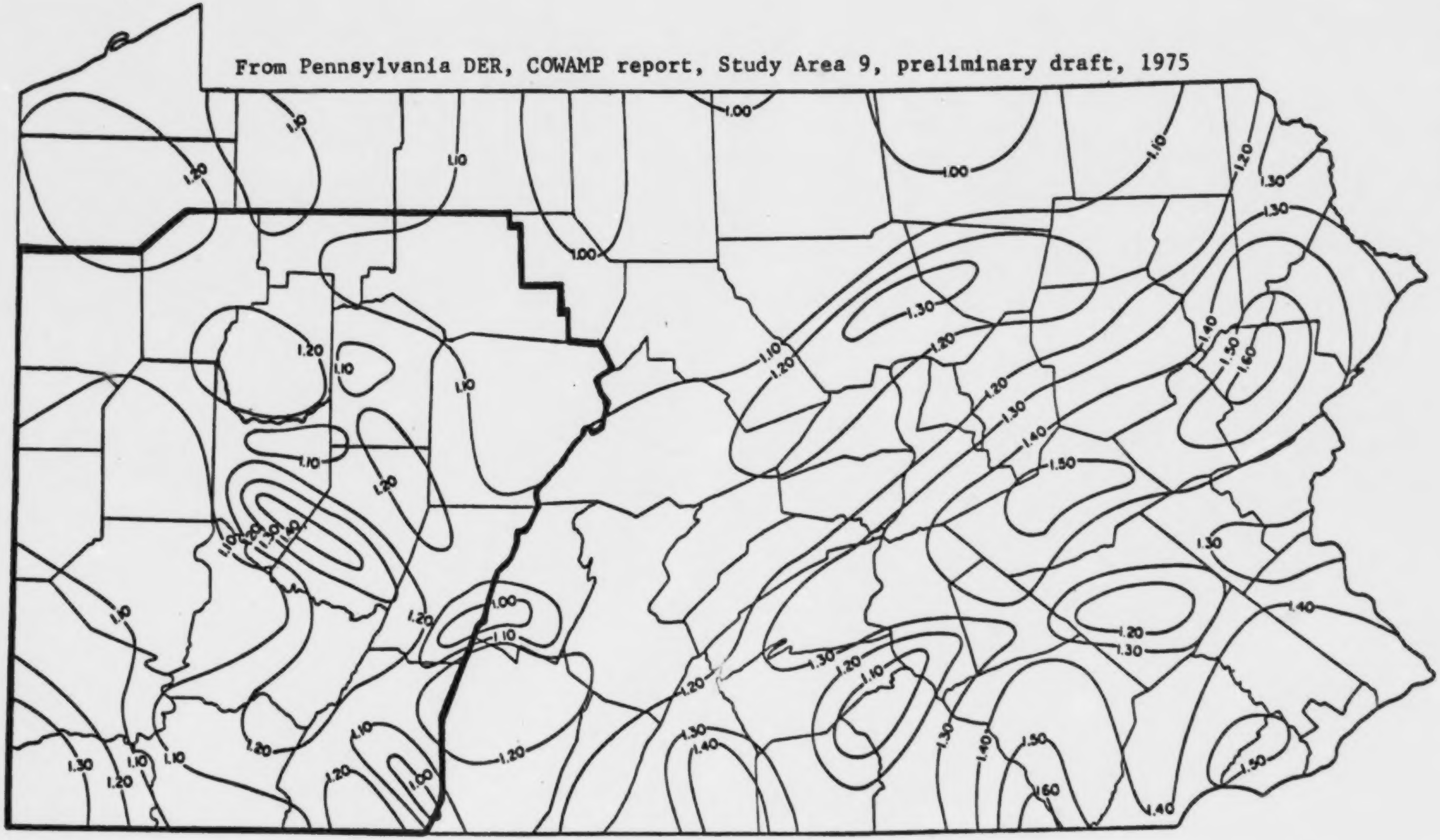


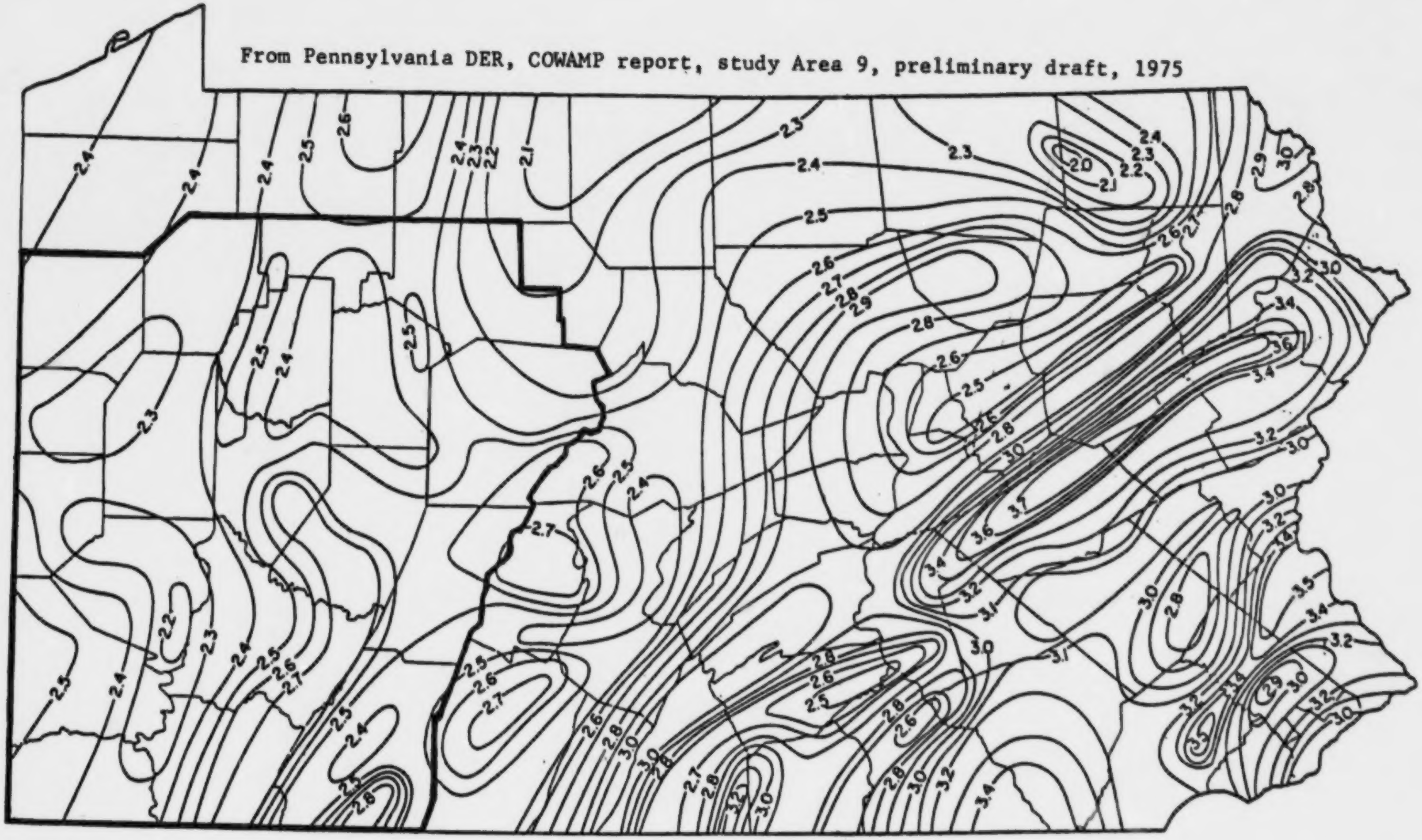
Figure 2.1.2.-3 **Mean annual precipitation at Pittsburgh**


1.00
1.00
1.00
1.10
1.10
1.10
1.20
1.20
1.30
1.30
1.30
1.20
1.20
1.10
1.10
1.10
1.20
1.30
1.40
1.40
1.50
1.60
1.50
1.30
1.40
1.20
1.30
1.10
1.20
1.30
1.30
1.40
1.50
1.60
1.40
1.50
1.00
1.10
1.20
1.20
1.10
1.00
1.20
1.20
1.10
1.20
1.30
1.40
1.10
1.30
1.20
1.10
1.10
1.20
1.30

From Pennsylvania DER, COWAMP report, Study Area 9, preliminary draft, 1975

ORBES counties in bold outline

Figure 2.1.2.-4 Rainfall in inches for 1-hour duration and 2.33-year return period



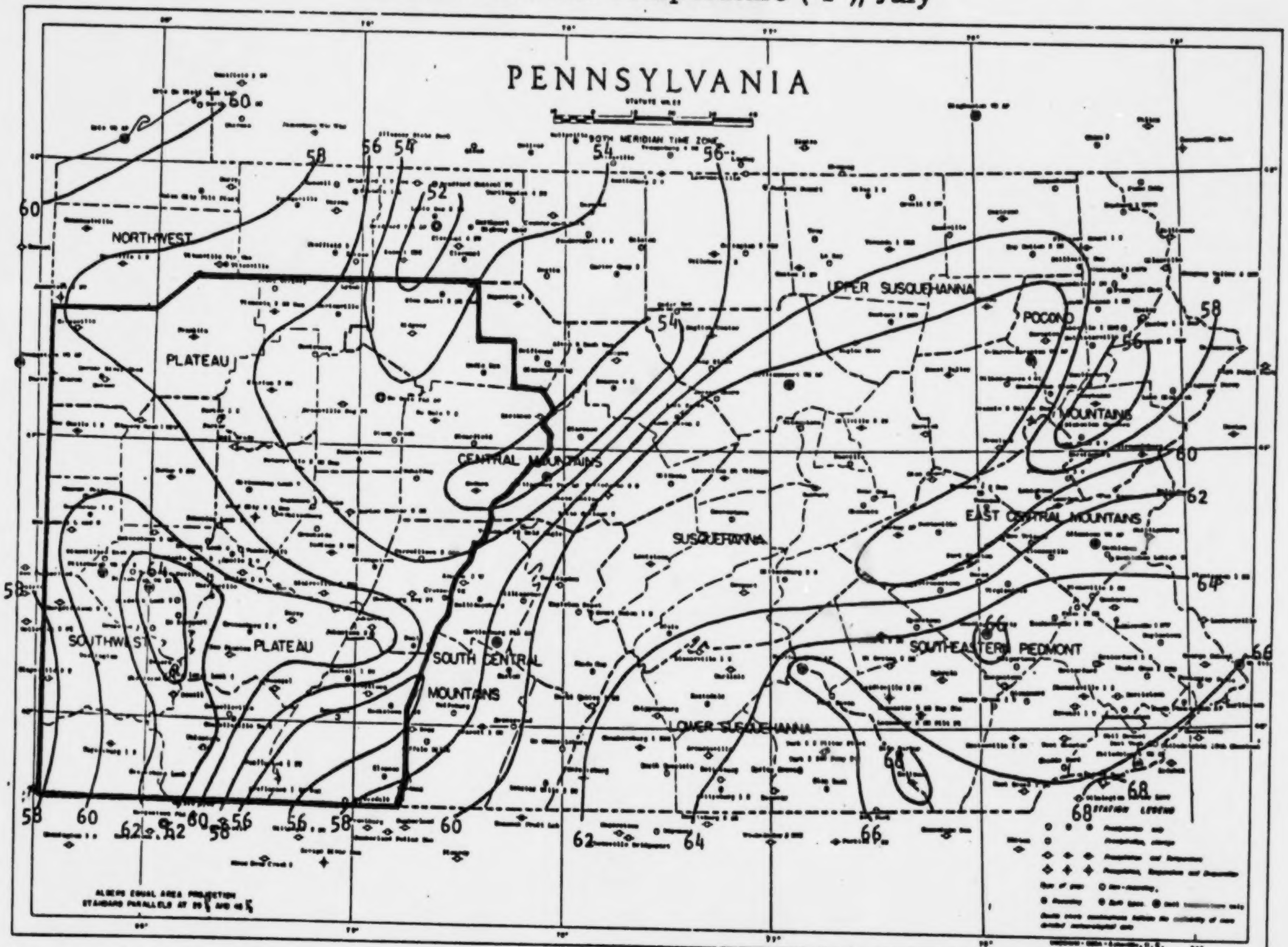
2.4
2.4
2.4
2.5
2.6
2.4
2.3
2.2
2.1
2.3
2.4
2.5
2.3
2.0
2.1
2.2
2.3
2.4
2.9
3.0
2.8
2.8
2.6
2.7
3.2
3.0
2.6
2.7
2.8
2.9
2.8
3.4
3.6
3.4
2.6
2.5
2.6
2.8
3.0
3.7
3.6
3.4
3.2
3.1
3.2
3.0
2.5
2.4
2.5
2.3
2.6
2.5
2.4
2.7
3.0
3.2
3.4
3.5
3.4
3.2
3.0
2.8
3.0
3.1
2.2
2.3
2.4
2.5
2.6
2.7
2.5
2.4
2.5
2.8
2.5
2.6
2.7
2.6
2.8
3.0
2.8
2.7
2.8
3.2
3.0
2.8
2.6
2.5
2.8
2.6
2.8
3.0
3.2
3.4
3.2
3.3
3.5
2.9
3.0
3.2
3.0
2.5
2.4

From Pennsylvania DER, COWAMP report, study Area 9, preliminary draft, 1975

ORBES counties in bold outline

Figure 2.1.2.-5. Rainfall in inches for 24-hour duration and 2.33-year return period

Mean Minimum Temperature (°F), July


PENNSYLVANIA
NORTHWEST
PLATEAU
CENTRAL MOUNTAINS
SOUTHWEST
PLATEAU
SOUTH CENTRAL MOUNTAINS
UPPER SUSQUEHANNA
POCONO
MOUNTAINS
EAST CENTRAL MOUNTAINS
SUSQUEHANNA
SOUTHEASTERN PIEDMONT
LOWER SUSQUEHANNA
52
54
56
58
60
62
64
66
68
STATION LEGEND
ALBERS EQUAL AREA PROJECTION

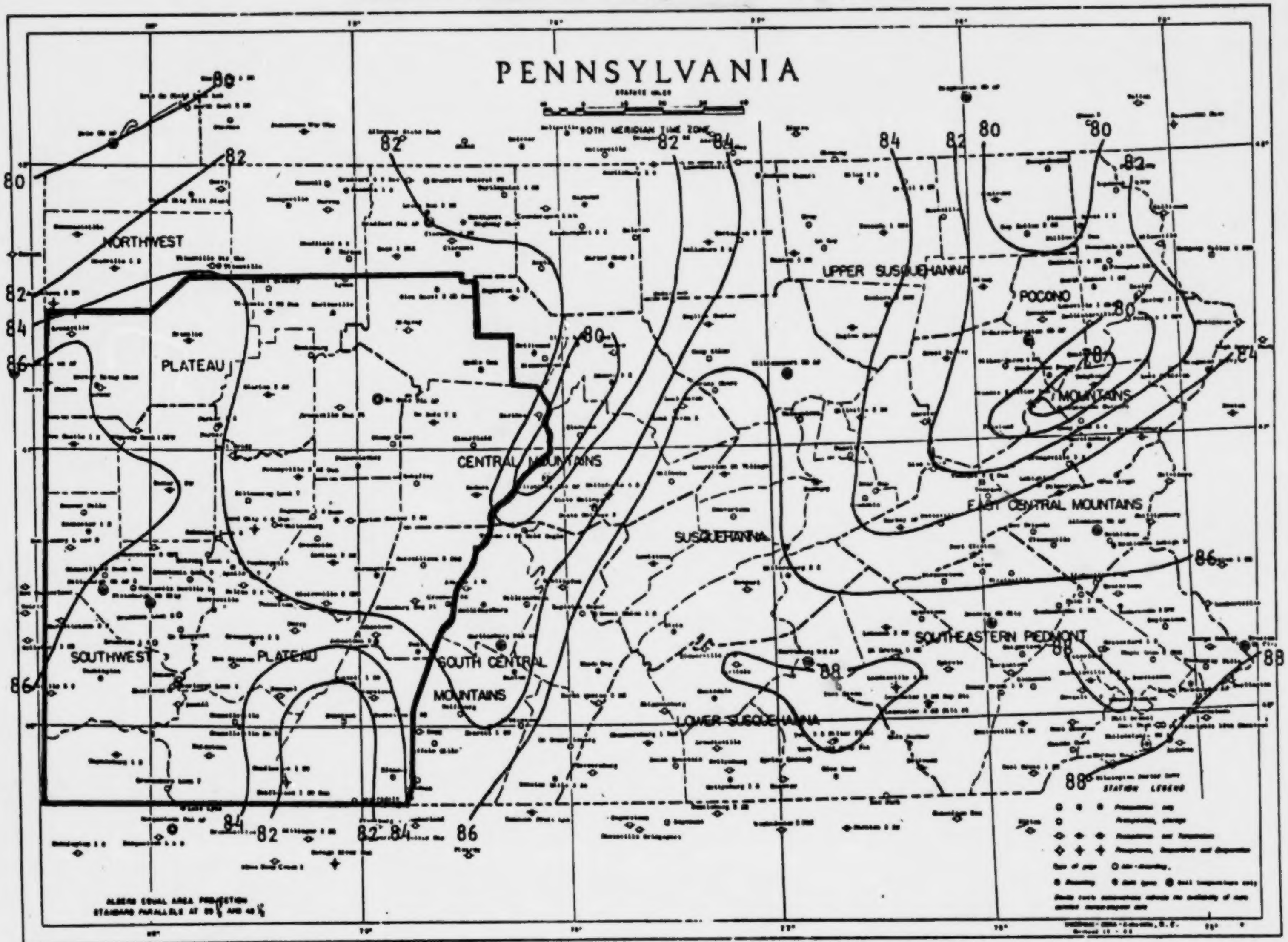
Based on the period 1931-60

Reproduced from best available copy.

ORBES counties in bold outline

Figure 2.1.2.-6

Mean Maximum Temperature (°F), July

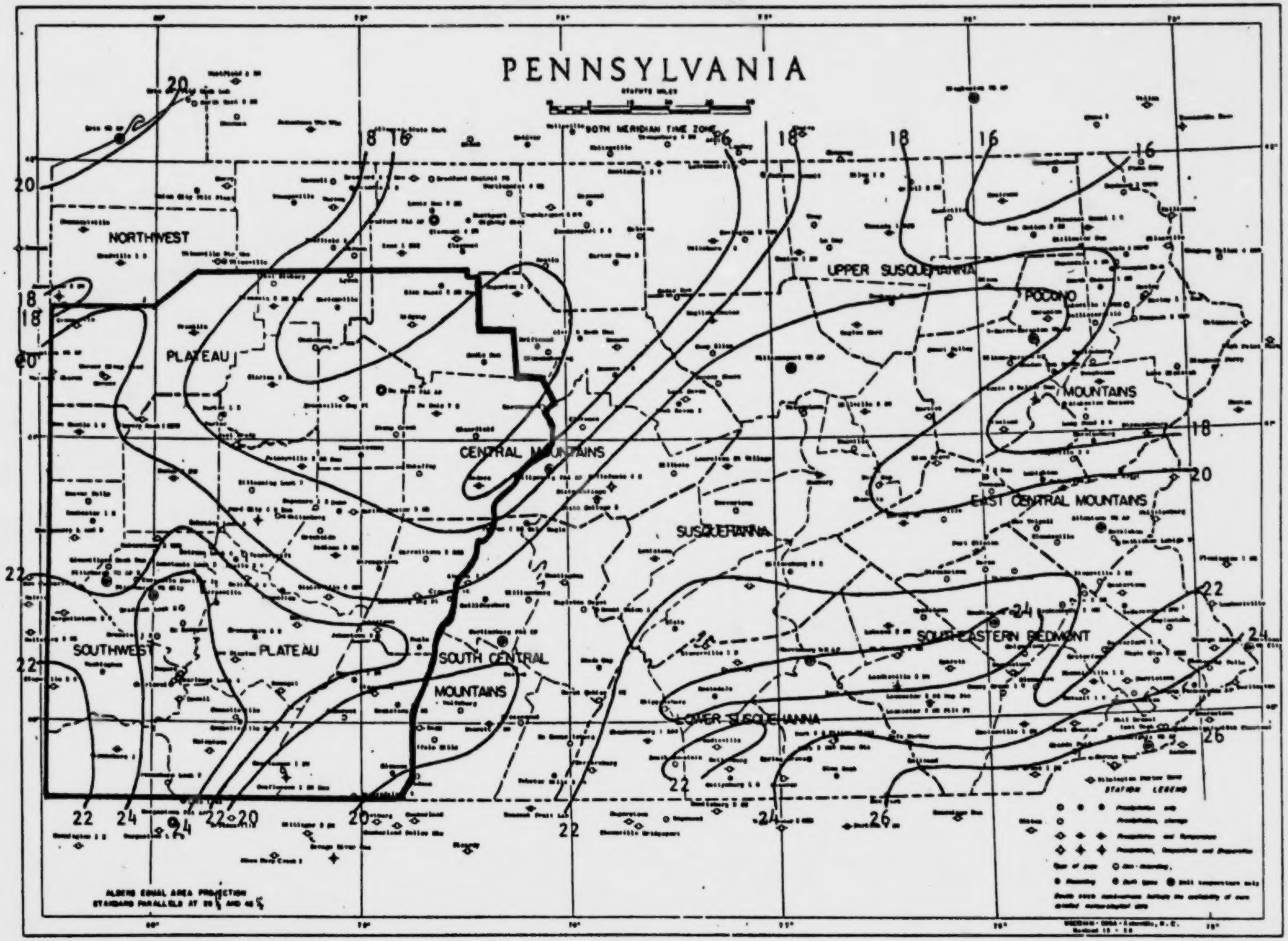

PENNSYLVANIA
80TH MERIDIAN TIME ZONE
NORTHWEST
PLATEAU
SOUTHWEST
PLATEAU
CENTRAL MOUNTAINS
SOUTH CENTRAL MOUNTAINS
SUSQUEHANNA
UPPER SUSQUEHANNA
POCONO
MOUNTAINS
EAST CENTRAL MOUNTAINS
SOUTHEASTERN PIEDMONT
LOWER SUSQUEHANNA
STATION LEGEND
80
82
84
86
88

Based on the period 1931-60

ORBES counties in bold outline

Figure 2.1.2.-7

Mean Minimum Temperature (°F), January

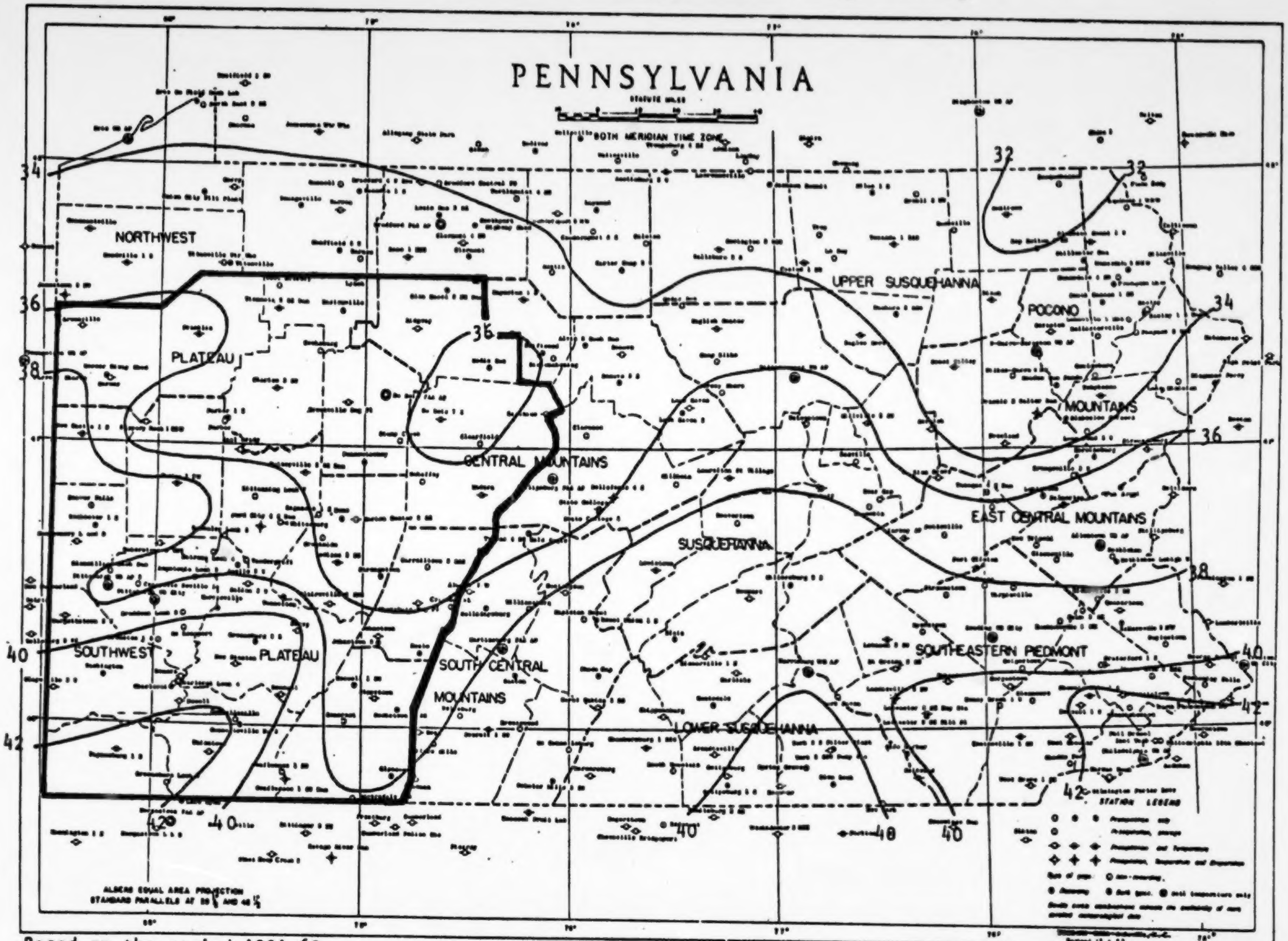

PENNSYLVANIA
STATUTE MILES
75TH MERIDIAN TIME ZONE
NORTHWEST
PLATEAU
CENTRAL MOUNTAINS
UPPER SUSQUEHANNA
POCONO
MOUNTAINS
EAST CENTRAL MOUNTAINS
SUSQUEHANNA
SOUTHWEST
PLATEAU
SOUTH CENTRAL
MOUNTAINS
SOUTHEASTERN PIEDMONT
LOWER SUSQUEHANNA
STATION LEGEND
ALBERS EQUAL AREA PROJECTION
STANDARD PARALLELS AT 29½° AND 45½°
16
18
20
22
24
26

Based on the period 1931-60

ORBES counties in bold outline

Figure 2.1.2.-8

Mean Maximum Temperature (°F), January

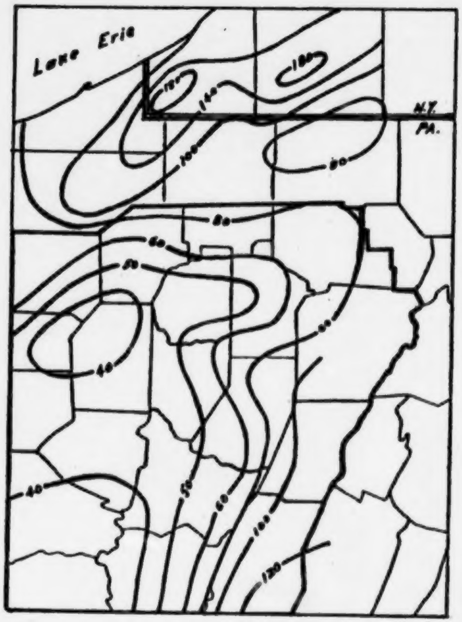

PENNSYLVANIA
STATUTE MILES
75TH MERIDIAN TIME ZONE
NORTHWEST
PLATEAU
CENTRAL MOUNTAINS
UPPER SUSQUEHANNA
POCONO
MOUNTAINS
EAST CENTRAL MOUNTAINS
SUSQUEHANNA
SOUTHWEST
PLATEAU
SOUTH CENTRAL
MOUNTAINS
LOWER SUSQUEHANNA
SOUTHEASTERN PIEDMONT
32
32
34
34
36
36
36
38
38
40
40
40
40
40
42
42
42
42
STATION LEGEND
ALBERS EQUAL AREA PROJECTION
STANDARD PARALLELS AT 29½° AND 45½°

Based on the period 1931-60

Reproduced from best available copy.

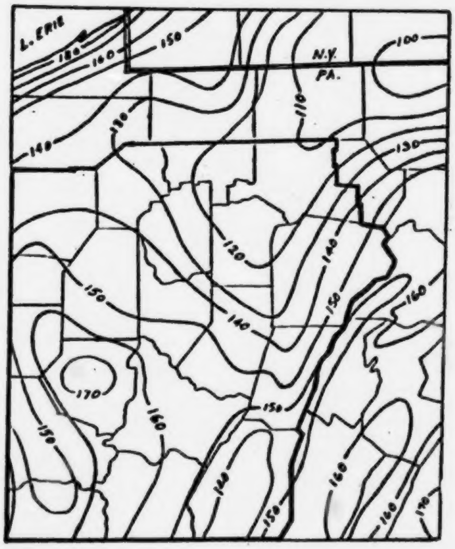
ORBES counties in bold outline

Figure 2.1.2.-9


Lake Erie
120
140
180
N.Y.
PA.
100
80
80
60
50
40
40
50
80
100
120
80

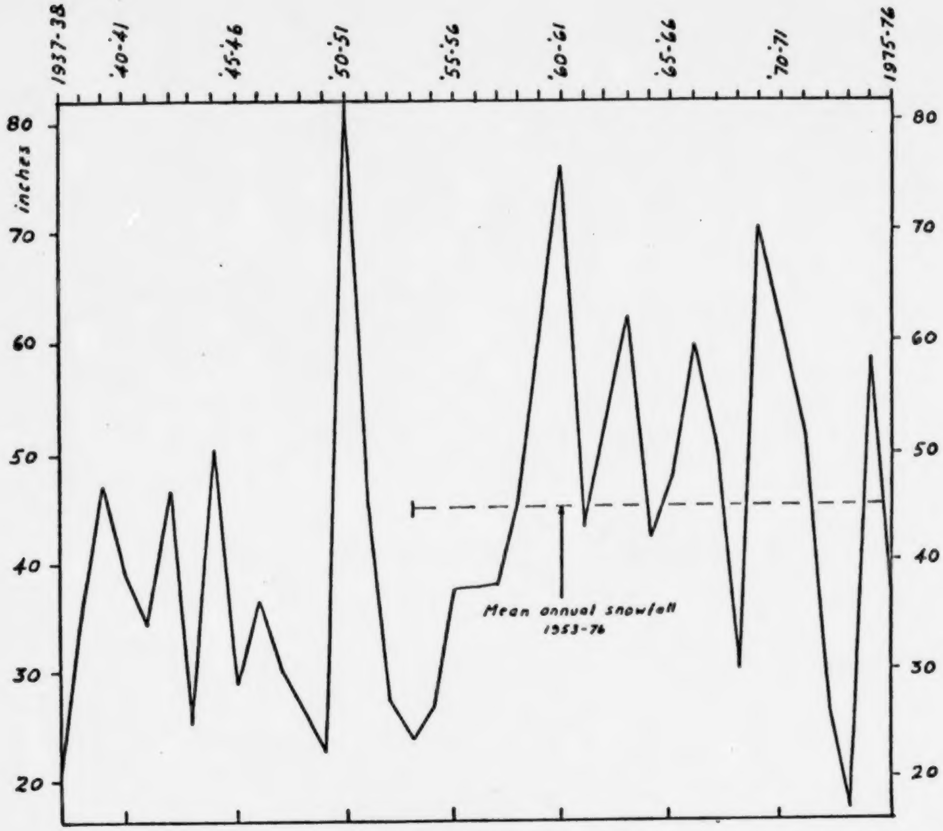
From U.S. Army Corps of Engineers, 1976

Figure 2.1.2.-10 Average annual snowfall 1962-72 (in inches)


L. ERIE
180
160
150
N.Y.
PA.
100
110
130
140
130
120
140
150
140
160
150
150
170
160
150
140
150
160
160
170

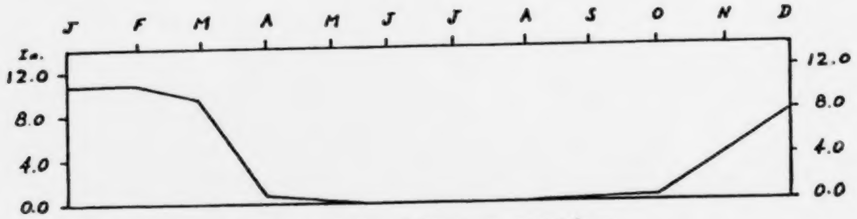
After Jennings, in Netting 1956

Figure 2.1.2.-11 Average length of growing season (in days)



Data from City station through 1951-52; from Greater Pgh. Airport from 1952-53 on

Figure 2.1.2.-12 Annual snowfall at Pittsburgh



Data from Greater Pgh. Airport station

Figure 2.1.2.-13 Mean monthly snowfall at Pittsburgh 1953-1976

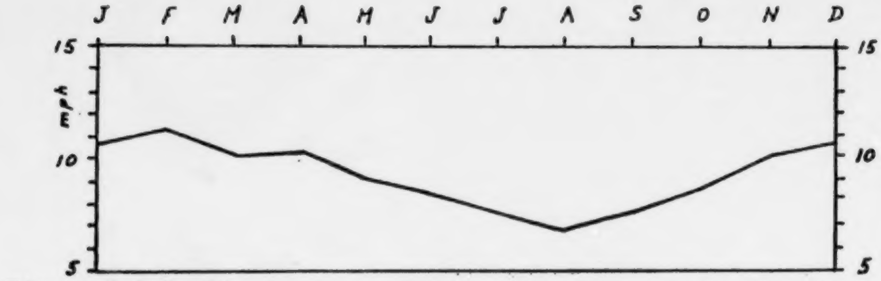


Figure 2.1.2.-14 Average monthly wind speed at Pittsburgh 1968-1977

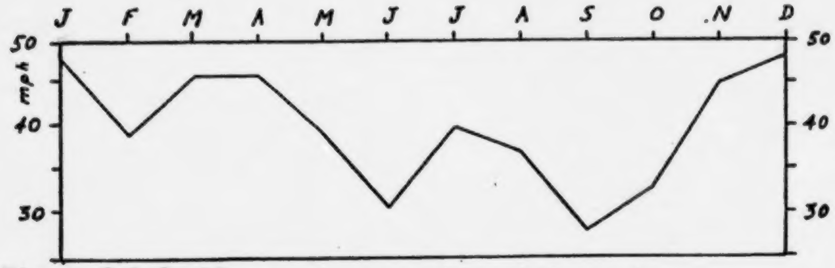


Figure 2.1.2.-15 Maximum monthly wind speed at Pittsburgh, 1968-1977

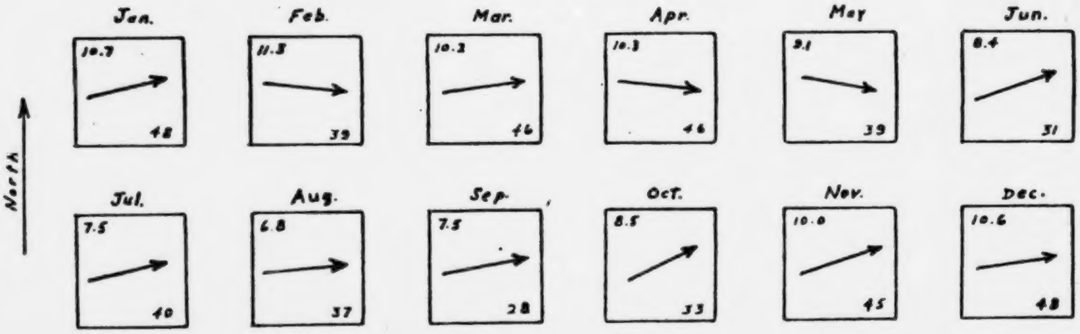


Figure 2.1.2.-16 Monthly wind at Pittsburgh, 1968-1977 Resultant wind*, average speed**, and maximum speed***

* Resultant wind shown by arrows; is vector sum of wind directions divided by number of observations

** Average speed (mph) in upper left corner of box

*** Maximum speed (mph) in lower right corner of box; is fastest mile in 1-minute interval

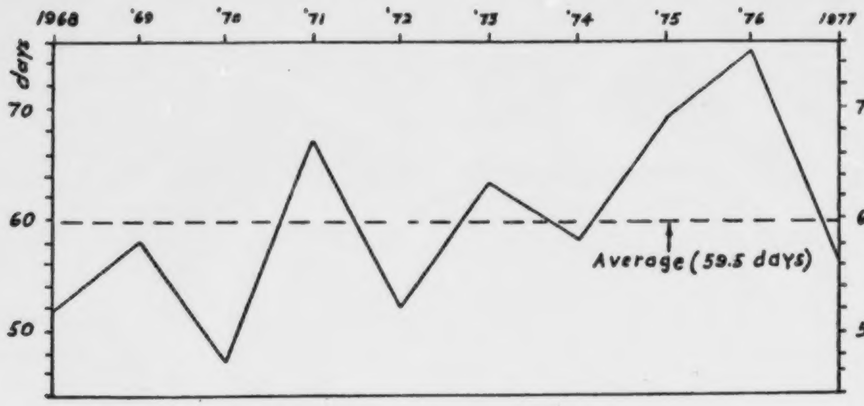


Figure 2.1.2.-17 Number of clear days at Pittsburgh

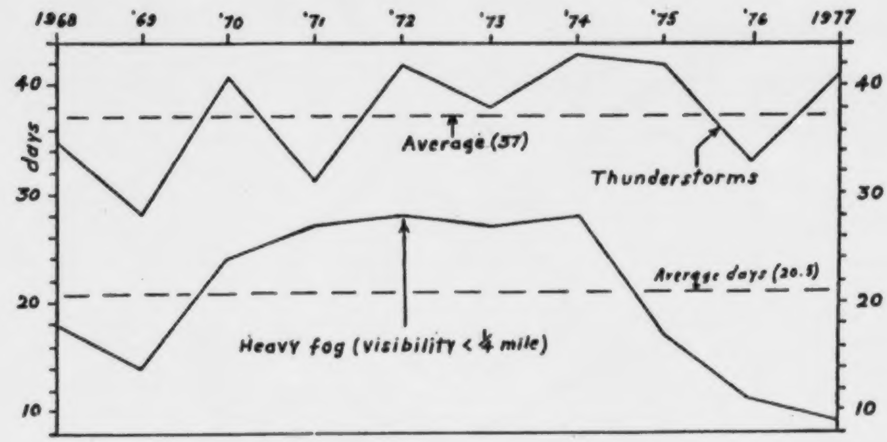


Figure 2.1.2.-18 Number of days of thunderstorms and heavy fog at Pittsburgh

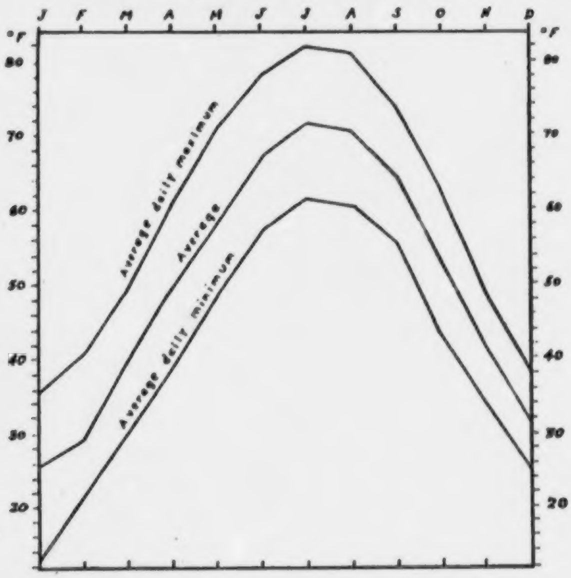
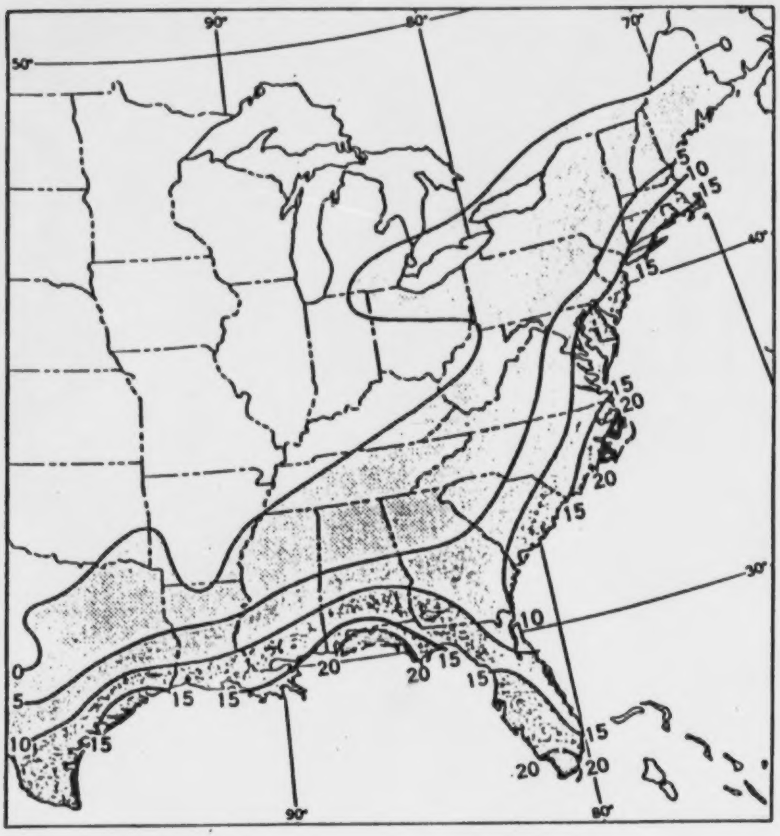


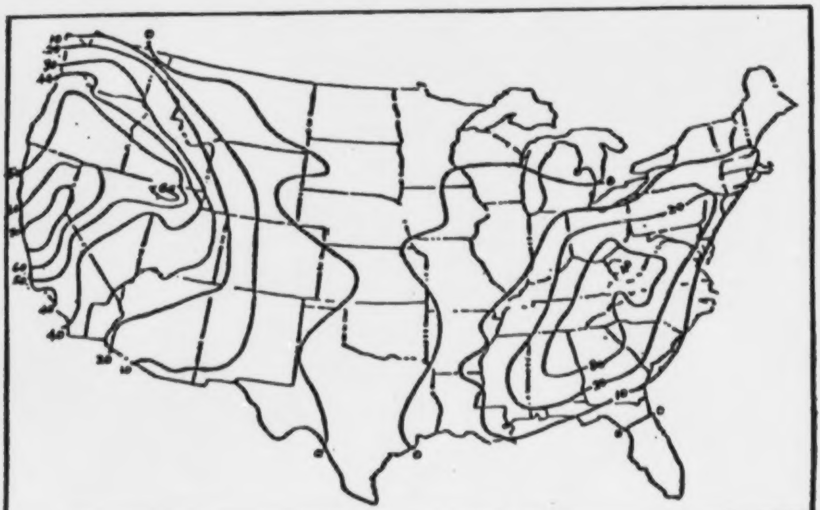
Figure 2.1.2.-19 Monthly temperature at Pittsburgh

Number of Times Destruction was Caused by Tropical Storms, 1901-1955



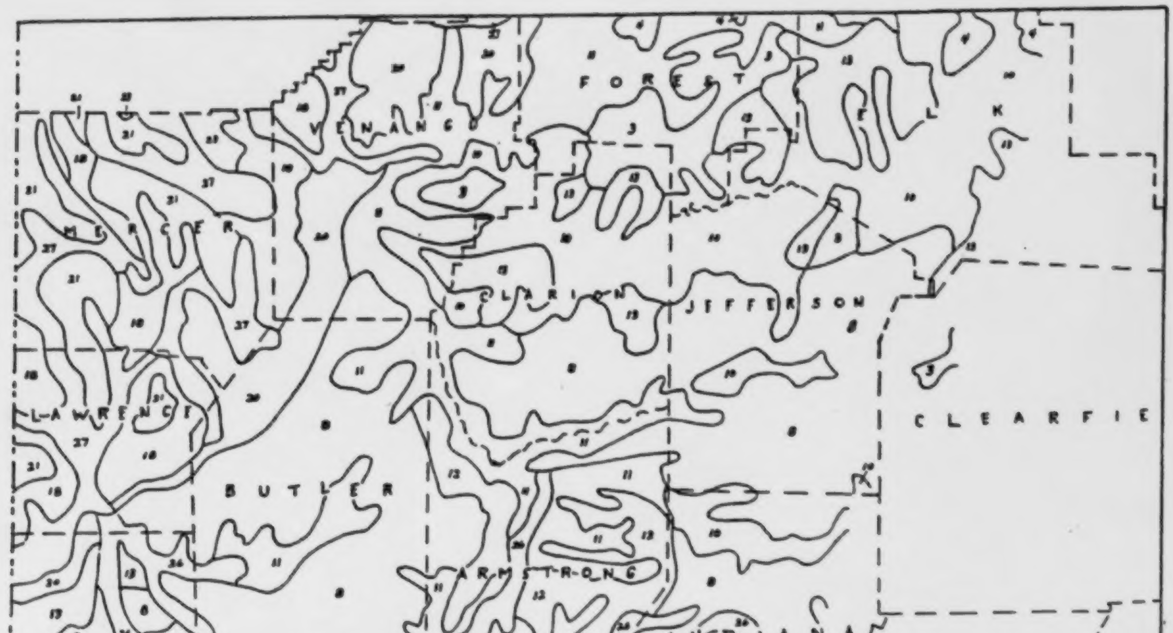
From USCOMM-ESSA

Figure 2.1.2.-20



From Holtzworth, 1972

Figure 2.1.2.-21 Total number of forecast-days of meteorological potential for air pollution expected in a 5-year period. Based on period Aug. 1, 1960-Apr. 13, 1970


FOREST
ELK
VENANGO
MERCER
CLARION
JEFFERSON
LAWRENCE
CLEARFIE
BUTLER
ARMSTRONG
INDIANA
BEAVER
CAMBRIA
ALLEGHENY
WESTMORELAND
WASHINGTON
SOMERSET
FAYETTE
GREENE
Scale
0 4 8 mi.

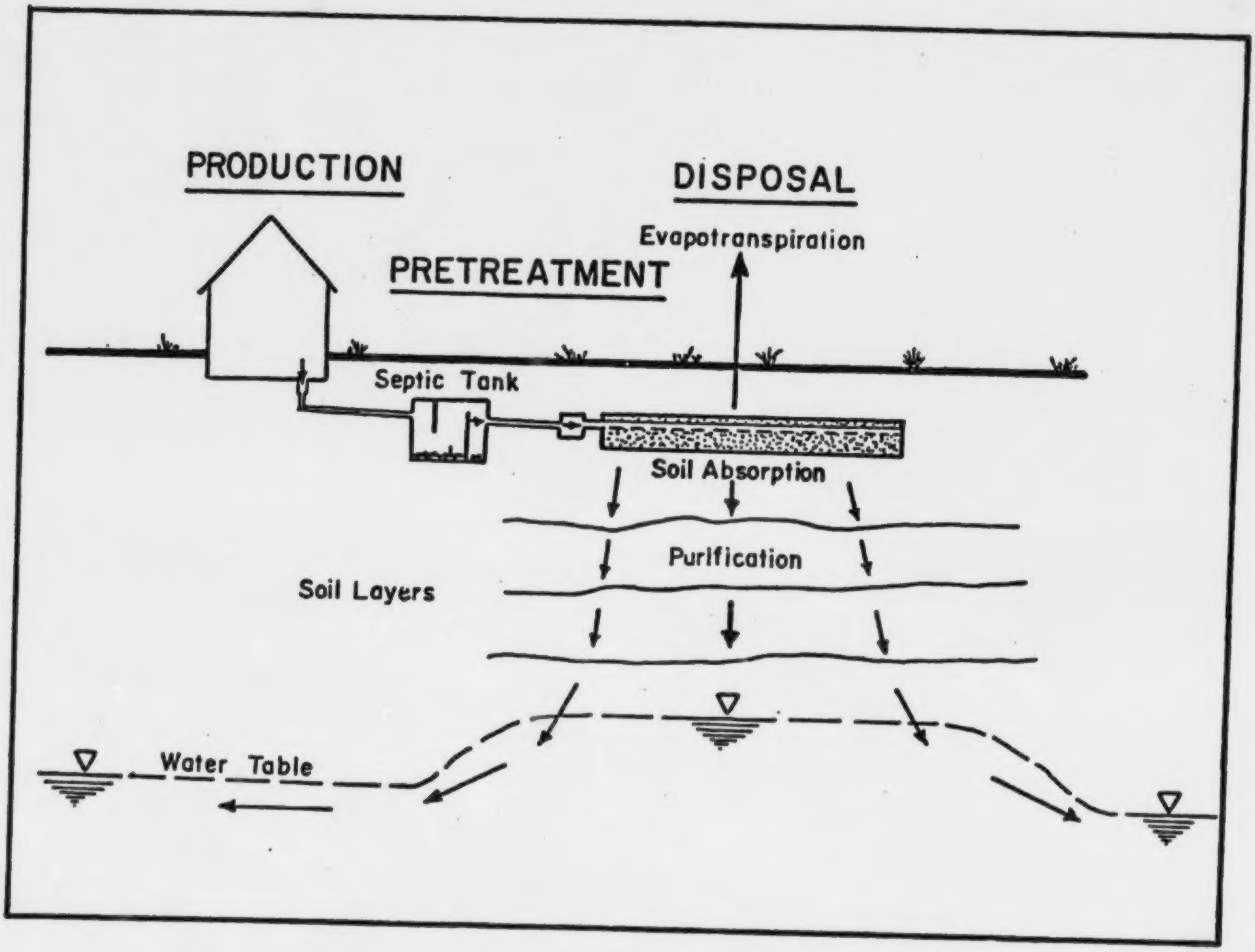
From U.S. Army Corps of Engineers Environmental Inventory of the Pittsburgh District, 1976

Figure 2.1.3.-1 General soil map
(see legend, following page)

Figure 2.1.3.-1 (Continued)

General Soil Map Legend

Map Unit	Soil Associations
1	Calvin-Lock Mill-Meckesville
2	Berks-Weikert-Bedington
3	Cookport-Clymer-Hazleton
4	Cookport-Cavode-Wharton
5	Culleoka-Weikert
6	Gilpin-Clymer-Cookport
7	Gilpin-Hazleton-Calvin
8	Gilpin-Ernest-Wharton
9	Gilpin-Upshur-Weikert
10	Hazleton-Cookport
11	Hazleton-Gilpin-Ernest
12	Rayne-Wharton-Ernest
13	Cavode-Wharton-Gilpin
14	Upshur-Gilpin-Clarksburg
15	Guernsey-Culleoka
16	Oquaga-Lordstown
17	Oquaga-Wellsboro-Morris
18	Canfield-Ravenna
19	Erie-Langford
20	Hanover-Alvira
21	Ravenna-Frenchtown
22	Sheffield-Platea
23	Venango-Cambridge
24	Volusia-Mardin-Lordstown
25	Chenango-Howard-Pope
26	Monongahela-Philo-Melvin
27	Wayland-Chenango-Braceville
28	Canadice-Caneada


PRODUCTION
DISPOSAL
Evapotranspiration
PRETREATMENT
Septic Tank
Soil Absorption
Purification
Soil Layers
Water Table

From Pennsylvania DER, COWAMP report, Study Area 8, 1975

Figure 2.1.3.-2 Standard septic tank-seepage bed system

REFERENCES

Bern, J. (1976) Residues from power generation: processing, recycling, and disposal. In: Land Application of Waste Materials. Soil Conservation Society of America, Ankeny, Iowa.

Briggs, R. P., and Kohl, W. R. (1976) Map showing major fold axes, satellite imagery lineaments, elongate aeroradioctivity anomalies, and lines of structural discontinuity, southwestern Pennsylvania and vicinity, U. S. Geol. Survey, Miscellaneous Field Studies, Map MF-815.

Carswell, L. D. and Bennett, G. D. (1963) Geology and hydrology of the Neshannock quadrangle, Mercer and Lawrence Counties, Pa. Geol. Survey, Water Resources Report, W15.

Cate, A. S. (1962) Subsurface structure of the plateau region of north-central and western Pennsylvania on top of the Oriskany Formation, Pa. Geol. Survey, Map 9.

Chiburis, E. F., Ahner, R. O., and Graham, T. (from 1975 on) Seismicity of the northeastern United States, Bulletins, Northeastern Seismic Network, Weston Observatory of Boston College and University of Connecticut.

Dailey, P. W., Jr. (1971) Climate of Pennsylvania, U. S. Department of Commerce/National Oceanic and Atmospheric Administration Environmental Data Service, Climatography of the United States No. 60-36.

Edmunds, W. E. (1972) Coal reserves of Pennsylvania: total, recoverable, and strippable (January 1, 1970), Pa. Geol. Survey, Information

Gallaher, J. T. (1973) Summary ground-water resources of Allegheny County, Pa. Geol. Survey, Water Resources Report, W35.

Gelburd, G. S. (1977) A study of the pH spectrum of individual raindrops. MSc(Hyg.) Thesis, Dept. Indus. Environ. Health Sciences, University of Pittsburgh, Pittsburgh, Pa.

Hadley, J. B. and Devine, J. F. (1974) Seismotectonic map of the eastern United States, U. S. Geol. Survey, Miscellaneous Field studies, Map MF-620.

Holtzworth, G. C. (1972) Mixing heights, wind speeds, and urban air pollution potential, Environmental Protection Agency.

Kane, R. (1974) A study of the acidic nature of precipitation. MSc (Hyg.) Thesis, Dept. Indus. Environ. Health Sciences, University of Pittsburgh, Pittsburgh, Pa.

King, E. R. and Zietz, I. (1978) The New York - Alabama lineament: geophysical evidence for a major crustal break in the basement beneath the Appalachian basin, Geology, vol. 6, p. 312-318, May.

Leggette, R. M. (1936) *Ground water in northwestern Pennsylvania*, Pa. Geol. Survey, Water Resources Report, W3.

Lohman, S. W. (1939) *Ground water in north-central Pennsylvania*, Pa. Geol. Survey, Water Resources Report, W6.

______________ (1938) *Ground water in south-central Pennsylvania*, Pa. Geol. Survey, Water Resources Report, W5.

Lytle, W. S. et al. (1977) *Oil and gas developments in Pennsylvania in 1976*, Pa. Geol. Survey, Progress Report 190.

Lytle, W. S., and Balogh, L. J. (1977) *Oil and gas fields of Pennsylvania*, Pa. Geol. Survey, Map No. 3.

________________________________ (1975) *Greater Pittsburgh Region oil and gas fields map*, Pa. Geol. Survey, Map 44.

Netting, M. G. (1956) *Geography of the Upper Ohio Valley* in "Man and the Water of the Upper Ohio Basin," edited by C. A. Tryon and M. A. Shapiro, Special Publication No. 1, Pymatuning Laboratory of Field Biology, University of Pittsburgh.

Newport, T. G. (1973) *Summary ground water resources of Clarion County*, Pa. Geol. Survey, Water Resources Report, W32.

_______________ (1973) *Summary ground water resources of Westmoreland County*, Pa. Geol. Survey, Water Resources Report, W37.

_______________ (1973) *Summary ground water resources of Washington County*, Pa. Geol. Survey, Water Resources Report W38.

Nieman, B. L. and Mahan, A. L. (1978) Impact of long-range transport of pollutants on air quality in the Commonwealth of Pennsylvania. Study by Teknekron, Inc. for U. S. EPA Office of Energy, Minerals, and Industry, Washington, D. C.

O'Neill, B. J., Jr. (1977) *Directory of the mineral industry in Pennsylvania*, Pa. Geol. Survey, Information Circular 54 (3rd Edition).

____________________ (1964) *Limestones and dolomites of Pennsylvania*, Part 1 of Pa. Geol. Survey Atlas of Pennsylvania's Mineral Resources, M50.

Pennsylvania Department of Environmental Resources (1975) *Comprehensive water quality management plan, Study Area 5*, (COWAMP) preliminary draft.

____ (1975) *Comprehensive water quality management plan, central Susquehanna River basin, Study Area 6*, (COWAMP) preliminary draft.

____ (1975) *Comprehensive water quality management plan, upper Allegheny River basin, Study Area 8*.

____ (1976) *Comprehensive water quality management plan, upper Monongahela River basin, Study Area 9*, (COWAMP) preliminary draft.

Piper, A. M. (1933) Ground water in southwestern Pennsylvania, Pa. Geol. Survey, Water Resources Report, W 1.

Poth, C. W. (1974) Geology and hydrology of the Mercer quadrangle, Mercer, Lawrence, and Butler Counties, Pa. Geol. Survey, Water Resources Report, W 16.

__________ (1973) Summary ground water resources of Armstrong County, Pa. Geol. Survey, Water Resources Report, W 34.

__________ (1973) Summary ground water resources of Butler County, Pa. Geol. Survey, Water Resources Report, W 36.

Poth, C. W. (1973) Summary ground water resources of Beaver County, Pa. Geol. Survey, Water Resources Report, W 39.

Schiner, G. R. and Kimmel, G. E. (1976) Geology and ground water resources of northern Mercer County, Pa. Geol. Survey, Water Resources Report W 33.

Shepps, V. C. (1959) Glacial geology of northwestern Pennsylvania, Pa. Geol. Survey, General Geology Report, G 32.

Sholes, M. A., and Skema, V. W. (1974) Bituminous coal resources in western Pennsylvania, Pa. Geol. Survey, Mineral Resources Report, M 68.

U. S. Army Corps of Engineers, Pittsburgh District (1976) Environmental resources inventory of the Pittsburgh District, prepared by Engineer Agency for Resources Inventories (Terrain Analysis Center), U. S. Army Engineer Topographic Laboratories, Ft. Belvoir, Va., draft copy.

U. S. Weather Bureau (1956) Maximum station precipitation for 1, 2, 3, 6, 12, and 24 hours, Part XIV: Pennsylvania Technical Paper No. 15, U. S. Government Printing Office, Washington, D. C.

Wagner, W. R. et al. (1975) Greater Pittsburgh Region structure contour map of Allegheny, Armstrong, Beaver, Butler, Washington, and Westmoreland Counties, Pa. Geol. Survey, Map No. 43.

2.1.4. TERRESTRIAL ECOLOGY

2.1.4.1. VASCULAR FLORA

A. Prehistoric Forest Composition

Subsequent to the final retreat of the ice from the Wisconsin Glaciation, Pennsylvania was subjected to a series of definite climatic fluctuations (1,2). Indeed, pollen studies (3,4,5) have indicated that five different postglacial, climatic periods occurred in this region. Generalized temperature and humidity regimes have been inferred (3,6) from the dominant forest associations as follows:

I. Following the retreat of ice, a spruce-fir forest (moist and cool climate)

II. A pine forest with substantial quantities of oak (dry, probably warmer climate)

III. An oak-beech-hemlock forest (moist and warm climate)

IV. An oak-hickory forest (dry and distinctly warm climate)

V. The present - oaks, beech, and hemlock prominent (more available moisture and probably cooler)

Approximately, four thousand years ago, during the warm and dry postglacial period IV, a "prairie peninsula" extended from the Mississippi River eastward through the state of Ohio (7). Certain species of prairie plants indigenous to the western U.S. are believed to have utilized this peninsula as a migratory route to the east (6, 7, 8). Even today, relict populations of the blazing star (Liatris spicata), a prairie flower, exist in northwestern Butler County at the Jennings Blazing Star Nature Reserve (8, 9) and a few miles to the east along what were the shores of glacial Lake Arthur (10). Other prairie plants which still inhabit western Pennsylvania include: gray-headed coneflower (Ratibidia pinnata), green milkweed (Asclepias viridiflora), false boneset (Kuhnia eupatoriodes), and big bluestem grass (Andropogon furcatus) (9, 10).

Although the prairie community is a negligible floristic group in our region today, the same xerothermic climatic period that favored its development also favored a northeastern migration of the white oak-hickory forest association into Pennsylvania (11). This forest is still the dominant association on the hilltops and uplands in the southwestern portion of the state.

B. Pre-settlement Forest Composition

The "potential natural vegetation" of western Pennsylvania has been mapped (Fig. 2.1.4.-1) along with the rest of the coterminous United States (12). This format presents a representation of the plant life"...that would exist today if man were removed from the scene and if the resulting plant succession were telescoped into a single moment." Emphasis has been placed on this denotation of "potential natural vegetation" because the exact influence of the American Indian upon forest composition and species distribution, although often assumed to be minimal, is unknown. It is known that the Indians often set fire to the woods to increase berry production, facilitate travel, and increase visibility (perhaps as an aid in hunting). Furthermore, many Indian tribes were nomadic, so that the total land area affected was considerably larger than would be expected (13). It has been speculated that the presence of oak forest along the Allegheny River and its tributaries is the result of fires set by Indians (14). Nonetheless, it has been estimated that more than 97% of the total state acreage was forested before the coming of the white man (15). The major non-forested areas are believed to have been a few natural meadows and extremely rugged mountain tops.

In spite of the scarcity of information regarding pre-settlement vegetation, it is known that many of the trees common today were also prevalent at the time of European colonization. Hough and Forbes (16) recognized three basic types of stands in the pre-settlement Allegheny High Plateau* region: white pine, hemlock-beech, and beech-maple. Early Pennsylvania pioneers were known to have utilized several types of trees including: maple (Acer) for sugar and timber; white oak (Quercus alba) for the construction of cabins; other oak species for firewood and fencing; chestnut (Castanea dentata) for fencing; walnut (Juglans) for gun stocks; and hickory (Carya), though not abundant, for fashioning farm tools and wagon axles (17). The presence and relative abundance of these trees in Pennsylvania at the time of European colonization suggests that Kuchler's map of potential vegetation is a reasonable approximation of pre-settlement species with the notable exception of chestnut. The association that Kuchler designates as Appalachian Oak Forest (Fig. 2.1.4.-1; Table 2.1.4.-1) was actually an oak-chestnut (Quercus - Castanea) forest prior to the chestnut blight of the early twentieth century (6). In fact, chestnut may have been the most common tree in pre-settlement Pennsylvania (18).

C. Past Impacts

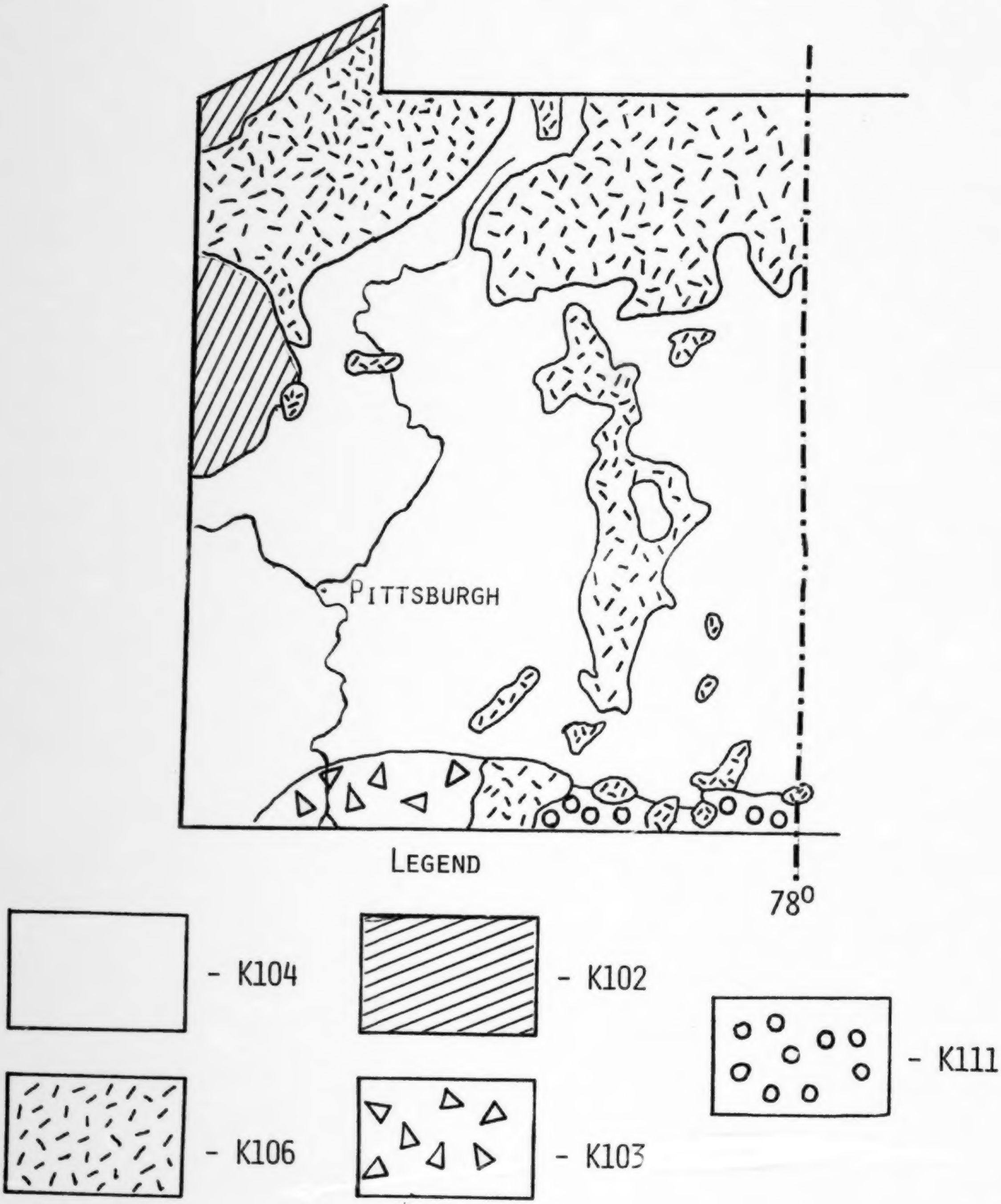
The Pennsylvania lumber industry had its origins in the eastern portion of the state prior to the 1682 arrival of William Penn.

---

*Venango, Forest, Elk, Upper Jefferson, Clearfield, and Clarion Counties are the Pennsylvania ORBES counties contained within this physiographic section.

FIGURE 2.1.4.-1

POTENTIAL NATURAL VEGETATION OF WESTERN PENNSYLVANIA


PITTSBURGH
LEGEND
78°
- K104
- K102
- K111
- K106
- K103

LEGEND: FOR DESCRIPTION OF K-TYPES SEE TABLE 2.1.4.-1
SCALE: 40 MILES TO THE INCH
SOURCE: ADAPTED FROM KUCHLER (12).

TABLE 2.1.4.-1

POTENTIAL NATURAL VEGETATION OF THE ORBES-PENNSYLVANIA STUDY REGION (KÜCHLER TYPES)

K102. Beech - Maple Forest (*Fagus* - *Acer*)

Physiognomy: Sugar maple (*Acer saccharum*); Beech (*Fagus grandifolia*).

Associated Species: Ohio buckeye (*Aesculus glabra*); Shagbark hickory (*Carya ovata*); White ash (*Fraxinus americana*); Black walnut (*Juglans nigra*); Tulip tree (*Liriodendron tulipifera*).

K103. Mixed Mesophytic Forest (*Acer* - *Aesculus* - *Fagus* - *Liriodendron* *Quercus* - *Tilia*)

Physiognomy: Tall, broadleaf deciduous forest.

Dominants: Sugar maple (*Acer saccharum*); Beech (*Fagus grandifolia*); Basswood (*Tilia heterophylla*); Tulip tree (*Liriodendron tulipifera*); Sweet buckeye (*Aesculus octandra*); Northern red oak (*Quercus rubra*); White oak (*Q. alba*).

Associated Species: Service-berry (*Amelanchier arborea*); Black birch (*Betula lenta*); American hornbeam (*Carpinus caroliniana*); Bitternut (*Carya cordiformis*); Pignut (*C. glabra*); Shagbark hickory (*C. ovata*); Redbud (*Cercis canadensis*); Flowering dogwood (*Cornus florida*); White ash (*Fraxinus americana*); Black walnut (*Juglans nigra*); Cucumber tree (*Magnolia acuminata*); Umbrella tree (*Magnolia tripetala*); Black gum (*Nyssa sylvatica*); American Hop Hornbeam (*Ostrya virginiana*); Sourwood (*Oxydendrum arboreum*); American basswood (*Tilia americana*); Hemlock (*Tsuga canadensis*).

K104. Appalachian Oak Forest (*Quercus*)

Physiognomy: Tall broadleaf deciduous forest.

TABLE 2.1.4.-1
Continued

Dominants: White Oak (*Quercus alba*); Northern Red Oak (*Quercus rubra*).

Associated Species: Red maple (*Acer rubrum*); Sugar maple (*A. saccharum*); Black birch (*Betula lenta*); Bitternut (*Carya cordiformis*); Pignut (*C. glabra*); Mockernut (*C. tormentosa*); Chestnut (*Castanea dentata*) formerly a co-dominant but now insignificant; Beech (*Fagus grandifolia*); Tulip tree (*Liriodendron tulipifera*); White Pine (*Pinus strobus*); Scarlet oak (*Quercus coccinea*); Black oak (*Q. velutina*); and Hemlock (*Tsuga canadensis*).

K106. Northern Hardwoods (*Acer* - *Betula* - *Fagus* - *Tsuga*)

Physiognomy: Tall, broadleaf deciduous forest with an admixture of needleleaf evergreen trees.

Dominants: Sugar maple (*Acer saccharum*);Yellow birch (*Betula allegheniensis*); Beech (*Fagus grandifolia*); Hemlock (*Tsuga canadensis*).

Associated Species: Striped maple (*Acer pennsylvanicum*); Red maple (*A. rubrum*); Mountain maple (*A. spicatum*); White ash (*Fraxinus americana*); Mountain laurel (*Kalmia latifolia*); White pine (*Pinus strobus*); Wild black cherry (*Prunus serotina*); Basswood (*Tilia americana*); American elm (*Ulmus americana*).

K111. Oak - Hickory - Pine (*Quercus* - *Carya* - *Pinus*)

Physiognomy: Medium tall to tall forest of broadleaf deciduous and needleleaf evergreen trees

Dominants: Hickory (*Carya sp.*); Shortleaf Pine (*Pinus echinata*); Loblolly Pine (*Pinus taeda*); White oak (*Quercus alba*); Post oak (*Q. stellata*).

Associated Species: Bitternut (*Carya cordiformis*); Pignut (*C. glabra*); Shagbark hickory (*C. ovata*); Flowering dogwood (*Cornus florida*); Tulip tree (*Liriodendron tulipifera*); Black gum (*Nyssa sylvatica*); Virginia pine (*Pinus virginiana*); Scarlet oak (*Quercus coccinea*); Black oak (*Q. velutina*).

SOURCE: Küchler (12)

Sawmills did not become established in the Pennsylvania ORBES region until 1776 (Allegheny County), 1805 (Clarion County) and 1825 (Elk County). The industry enjoyed increasing total lumber productivity after the Civil War. National demand for lumber soared at this time due to intensive rebuilding efforts (19). The strain on Pennsylvania's forest resources was augmented by exportation to foreign markets that "...clamored for our forest products, the finest trees and lumber to be purchased on the world's market" (20).

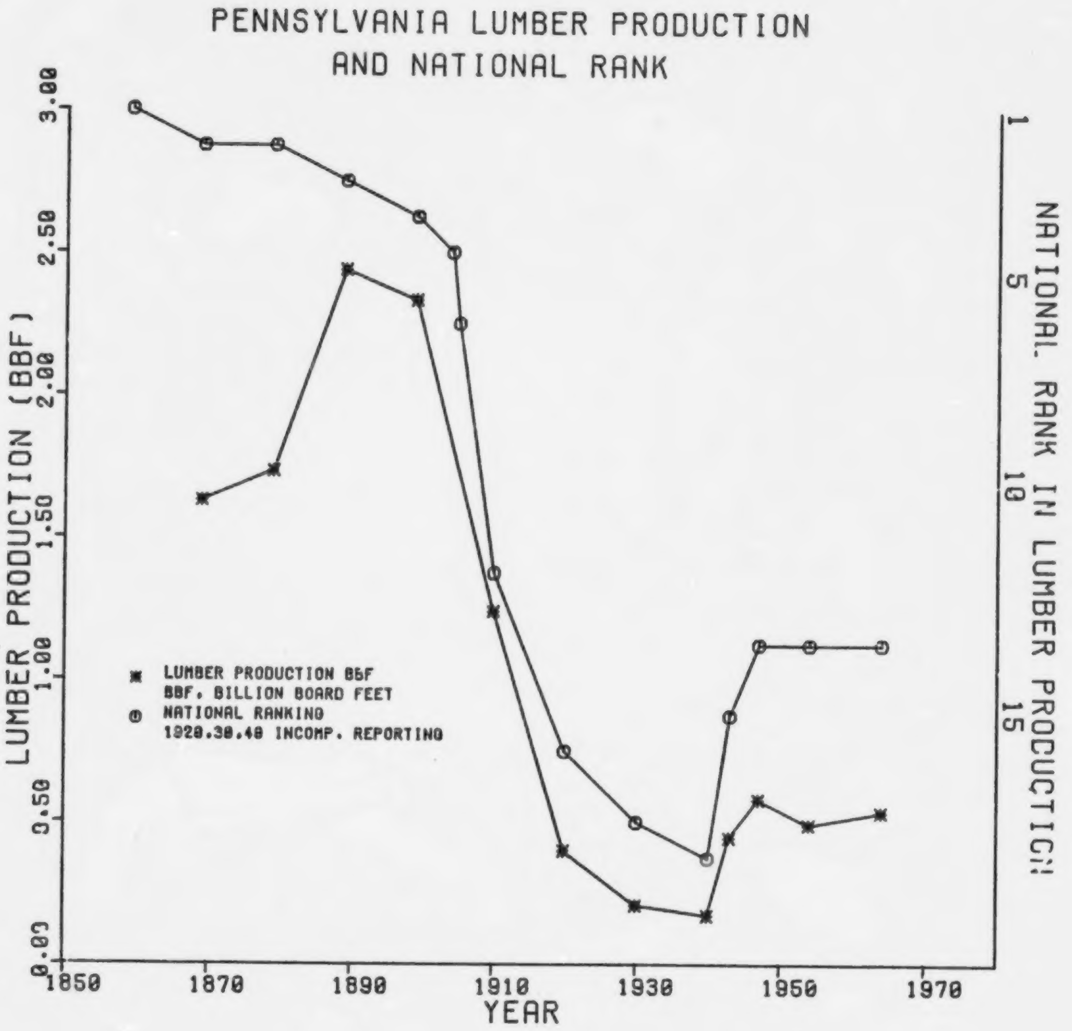
This overzealous lumbering had deforested much of Pennsylvania by the beginning of the twentieth century. Marquis (14) notes that "between 1890 and 1920," the virgin and partially cut forests were almost completely clear-cut in what must have been the highest degree of forest utilization the world has ever seen in any commercial lumbering area." In addition, the presence of good farming soils in western Pennsylvania and the proximity of the area to a big market place (Pittsburgh) further prompted the clearing of forested lands during the nineteenth century. The industrialization and urbanization of Allegheny County also resulted in the deforestation of considerable tracts of land in the southwestern corner of the Commonwealth. The surface mining of coal has been, and continues to be, an activity which temporarily removes parcels of land from the forested condition.

The sharp decline in total lumber production (Fig. 2.1.4.-2) evident throughout the early 1900's was due to a decrease in softwood production. Softwood constituted as much as three-fourths of the total lumber production in the late 1800's, but had plummeted to less than one-fourth of the total by 1969 (24). Pine and hemlock comprised the bulk of softwood used as lumber during this period. Table 2.1.4.-2 delineates hard- and softwood species found on commercial forest lands in Pennsylvania.

Hardwood production has remained relatively constant over the last century. Although Pennsylvania was nationally ranked sixteenth in total lumber production for 1969 (see Fig. 2.1.4.-2), it merited second place in hardwood production for the same year. Consequently, the decline in national rank for total lumber production was due to a combination of excessive softwood harvesting and the expansion of the lumber industry in the Pacific Northwest.

Our forest lands are still well suited for timber production. Approximately 98% of the state is theoretically capable of growing commercial timber (27). The net volume of total growing stock on commercial forest land within the Pennsylvania ORBES region in 1965 amounted to 5.15 billion cubic feet or 28.9% of the state total. Modern forest management and controlled harvesting has greatly improved the quantity and quality of Pennsylvania's forested lands. Between the 1955 and 1965 forest surveys, the statewide average for annual net growth of the growing stock (615 million cubic feet) was three times the cut (204 million cubic feet) (25). Six of the top ten lumber harvest counties

FIGURE 2.1.4.-2



Adapted from data in Pa. Dept. of Commerce (21) and Reynolds and Pierson (22) with corrections by the U.S. Forest Service (23).

TABLE 2.1.4.-2

LIST OF COMMERCIAL TREE SPECIES FOUND ON FOREST SURVEY SAMPLE PLOTS IN THE STATE OF PENNSYLVANIA

SOFTWOODS	
Virginia pine	*Pinus virginiana*
Other yellow pines:	
Pitch pine	*Pinus rigida*
Table-Mountain pine	*Pinus pungens*
Eastern white pine	*Pinus strobus*
Red pine	*Pinus resinosa*
Eastern hemlock	*Tsuga canadensis*
Other softwoods:	
Spruce	*Picea* sp.
Tamarack	*Larix laricina*
Eastern redcedar	*Juniperus virginiana*
Northern white-cedar	*Thuja occidentalis*
HARDWOODS	
Select white oaks:	
White oak	*Quercus alba*
Swamp white oak	*Quercus bicolor*
Bur oak	*Quercus macrocarpa*
Select red oaks:	
Northern red oak	*Quercus rubra*
Other white oaks:	
Chestnut oak	*Quercus prinus*
Post oak	*Quercus stellata*
Other red oaks:	
Black oak	*Quercus velutina*
Scarlet oak	*Quercus coccinea*
Pin oak	*Quercus palustris*
Willow oak	*Quercus phellos*
Hickory	*Carya* sp.
Yellow birch	*Betula alleghenienis*

TABLE 2.1.4.-2 (Cont.)

Sugar maple	*Acer saccharum*
Soft maples:	
Red maple	*Acer rubrum*
Silver maple	*Acer saccharinum*
American beech	*Fagus grandifolia*
Blackgum	*Nyssa sylvatica*
Sweetgum	*Liquidambar styraciflua*
Ash	*Fraxinus* sp
Aspen	*Populus* sp.
American basswood	*Tilia americana*
Yellow-popular	*Liriodendron tulipifera*
Black walnut	*Juglans nigra*
Black cherry	*Prunus serotina*
American sycamore	*Platanus occidentalis*
Black locust	*Robinia pseudoacacia*
Other hardwoods:	
Butternut	*Juglans cinerea*
Cucumbertree	*Magnolia acuminata*
Elm	*Ulmus* sp.
Flowering dogwood	*Cornus florida*
Paper birch	*Betula papyrifera*
Sweet birch	*Betula lenta*
Willow	*Salix* sp.
Yellow buckeye	*Aesculus octandra*

SOURCES: Ferguson (25); Little (26)

(total lumber) were contained within the ORBES region in 1964 (see Table 2.1.4.-3). Somerset County is an exceptionally important harvest site; it yields substantial quantities of a wide variety of tree types. Several counties with high human population densities (Allegheny, Beaver, Lawrence, and Washington) have low growing stocks and consequently are of minimal importance as lumber producers. Conversely, Elk County has a very high growing stock (608.4 million cubic feet) and yet it is harvested for only small to modest quantities of timber.

D. Current Degree of Forestation

At the present time, forested lands are defined as those areas in which: (a) at least ten percent of the land is stocked with trees of any size and are capable of producing timber or other wood products, or of exerting an influence on the climate or on the water regime; (b) land from which the trees described in (a) have been removed to less than ten percent stocking and that has not been developed for other use; and (c) afforested areas. Forest tracts of less than one acre, isolated strips of timber less than one hundred and twenty feet wide, and abandoned fields and pastures not yet stocked to ten percent with trees are not considered to be forested lands.

Surprisingly, the amount of forested land in the entirety of the Pennsylvania ORBES region has been increasing during the last century (see Fig. 2.1.4.-3). The highest rate of increase (sharpest slope) in Figure 2.1.4.-3 occurs during the 1950's and 60's. This dramatic increase has been ascribed to a widespread abandonment of cropland and treeless pasture land due to the migration of much of the agriculture industry to the midwestern states (25).

Not only has the totality of the Pennsylvania ORBES region undergone a reforestation, but each of the individual counties within the region have also experienced increases in forested land (see Table 2.1.4.-4). The current degree of county-specific forestation is depicted in Figure 2.1.4.-4.

E. Modern Forest Composition

The four generalized forest associations depicted in Figure 2.1.4.-1 and Table 2.1.4.-1 roughly approximate the major forest communities present in our region today. However, the characterization of the majority of the Pennsylvania ORBES region as either Appalachian Oak Forest (12) or Mixed Mesophytic Forest (6) is an oversimplification. Localized variations in abiotic factors (climate, soils, etc.) have permitted considerable interdigitation and mixing of forest types. Furthermore, the land-use variations imposed by man have severely limited certain types and have largely restricted endemic species to areas of rugged topography. The available data from both old growth stands and mature second growth stands indicates that dry, upland areas are oak-

TABLE 2.1.4.-3

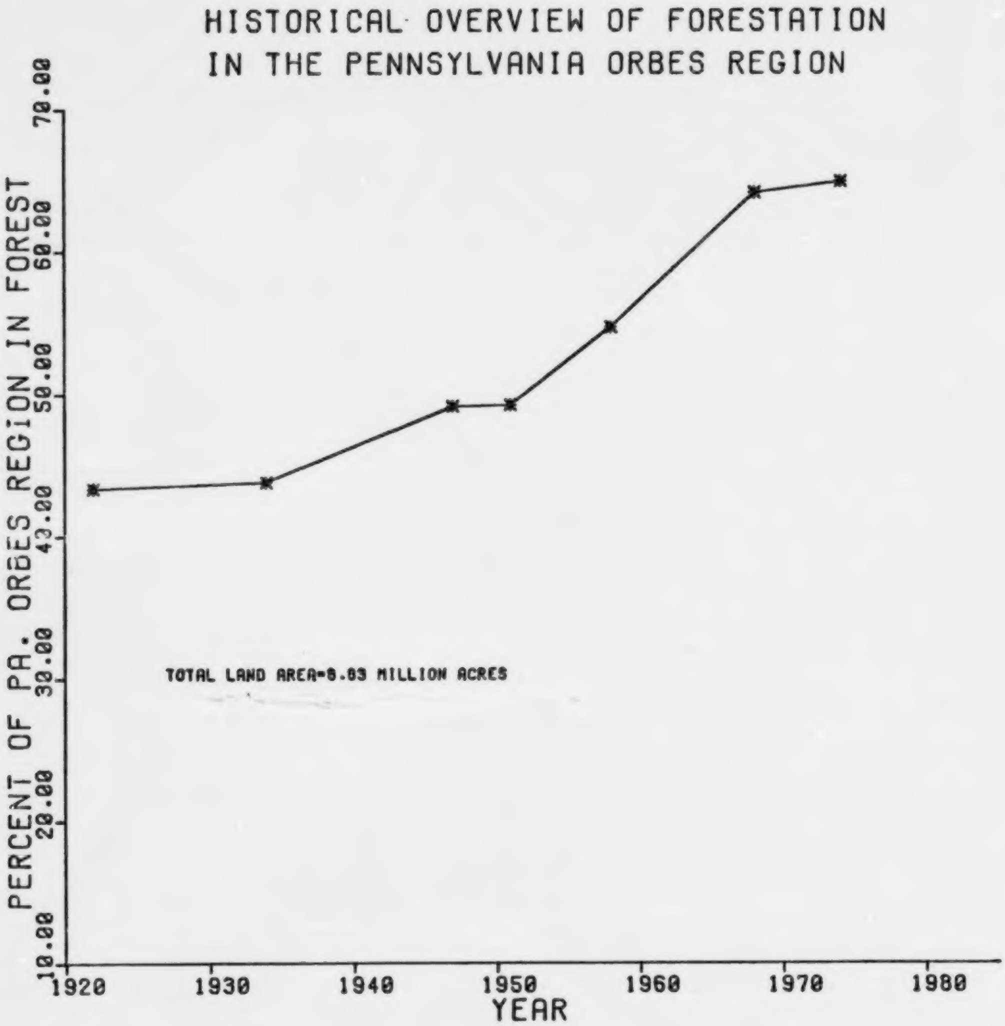
1964 HARVEST RANKINGS FOR ORBES COUNTIES AMONG THE TOP TEN COUNTIES IN THE STATE

	Ash	Basswood	Beech	Birch	Black Cherry	Hickory	Hard Maple	Soft Maple	White Oak	Red Oak	Yellow Poplar	Black Walnut	White Pine	Yellow Pine	Hemlock	Total Lumber
ALLE	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
ARMS	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
BEAV	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
BUTL	-	-	-	4	5	7	-	-	-	-	-	-	-	-	-	-
CAMB	-	-	3	-	-	-	-	7	-	-	-	-	-	9	-	-
CLAR	-	-	-	-	-	-	-	6	6	1	-	1	-	-	7	4
CLEA	-	-	-	-	10	-	-	-	-	7	-	-	2	6	1	8
ELK	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
FAYE	-	3	-	-	-	10	-	-	-	9	1	9	-	-	-	5
FORE	-	-	10	-	7	-	-	8	-	-	-	-	9	-	-	-
GREE	-	-	-	-	-	-	-	-	-	-	-	7	-	-	-	-
INDI	7	-	-	-	-	-	-	-	-	8	6	-	-	-	-	9
JEFF	-	-	-	-	8	-	-	9	-	4	-	-	-	-	-	10
LAWR	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
MERC	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SOME	4	4	-	9	3	1	5	2	8	2	2	-	-	-	-	2
VENA	-	-	-	-	-	-	-	5	2	3	-	-	-	-	-	-
WASH	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
WEST	-	-	-	-	-	-	-	-	-	-	4	-	-	-	-	-

(-) County was not ranked among top ten

SOURCE: Pa. Dept. of Commerce (21).

FIGURE 2.1.4.-3



SOURCES: Adapted from data in Table 2.1.4.-4.

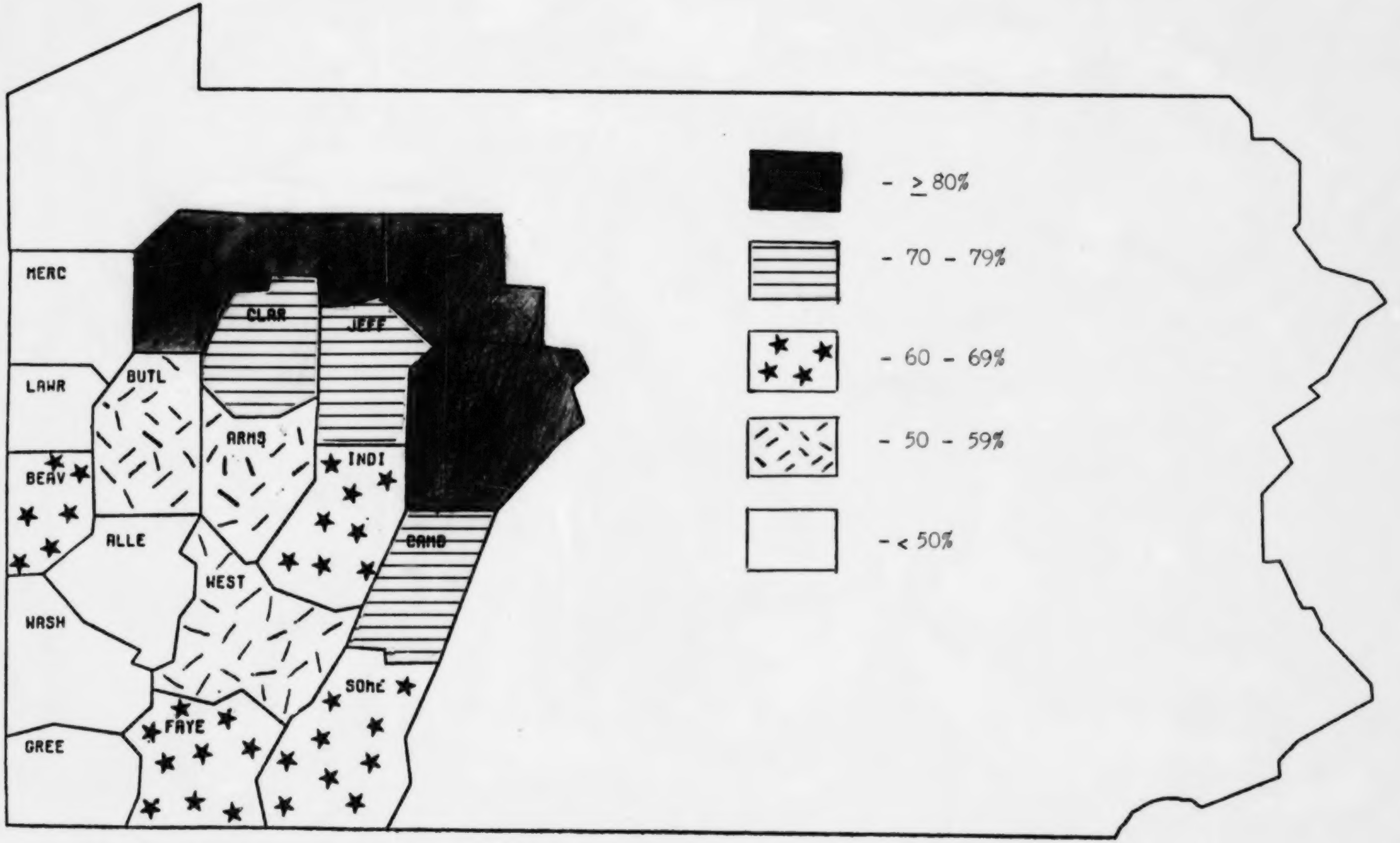
TABLE 2.1.4.-4

HISTORICAL TRENDS IN COUNTY-SPECIFIC FORESTATION
(ACRES X 1,000)

COUNTY NAME	TOTAL LAND ACRES	ESTIMATED FOREST ACREAGE YEAR							ESTIMATED PERCENTAGE FORESTED YEAR						
		1922	1934	1947	1951	1958	1968	1974	1922	1934	1947	1951	1958	1968	1974
ALLE	465.9	109.2	74.6	135.0	147.5	171.4	191.2	206.3	23.4	16.0	29.0	31.7	36.8	41.0	44.3
ARMS	417.3	127.9	127.9	198.1	170.7	211.7	233.6	234.7	30.6	30.6	47.5	40.9	50.7	56.0	56.3
BEAV	281.6	77.4	77.4	104.4	100.4	116.7	163.1	179.3	27.5	27.5	37.1	35.7	41.4	57.9	63.7
BUTL	508.2	105.6	150.8	156.4	192.0	202.8	284.9	292.5	20.8	29.7	30.8	37.8	39.9	56.1	57.6
CAMB	442.9	257.0	249.3	270.7	259.0	315.5	308.4	319.7	58.0	56.3	61.1	58.5	71.2	69.6	72.2
CLAR	382.1	153.0	159.3	193.2	189.6	204.9	290.8	291.6	40.0	41.7	50.6	49.6	53.6	76.1	76.3
CLEA	729.0	500.0	535.8	527.5	541.5	603.4	643.5	644.8	68.6	73.5	72.4	74.3	82.8	88.3	88.4
ELK	516.5	417.0	443.5	458.4	456.3	447.9	480.6	481.1	80.7	85.9	88.8	88.3	86.7	93.1	93.2
FAYE	513.3	335.0	238.0	297.0	264.5	326.4	351.2	355.0	65.3	46.4	57.9	51.5	63.6	68.4	69.2
FORE	268.2	233.6	236.2	245.5	247.8	242.5	250.6	250.3	87.1	88.1	91.5	92.4	90.4	93.4	93.3
GREE	369.9	89.4	47.9	90.7	115.5	137.8	157.0	158.1	24.2	12.9	24.5	31.2	37.2	42.4	42.7
INDI	528.0	176.0	212.4	249.4	221.7	253.7	316.9	316.7	33.3	40.2	47.2	42.0	48.0	60.0	60.0
JEFF	417.3	221.0	233.6	232.1	283.4	262.9	314.1	317.4	53.0	56.0	55.6	67.9	63.0	75.3	76.1
LAWR	234.9	49.0	43.0	40.2	50.3	55.2	101.9	102.2	20.9	18.3	17.1	21.4	23.5	43.4	43.5
MERC	428.8	106.7	98.4	97.0	86.6	93.7	166.4	168.1	24.9	22.9	22.6	20.2	21.8	38.8	39.2
SOME	689.9	400.0	354.3	372.8	379.0	433.8	467.0	466.8	58.0	51.4	54.0	54.9	62.9	67.7	67.7
VENA	433.9	176.0	251.3	239.3	278.8	296.0	371.4	372.3	40.6	57.9	55.2	64.3	68.2	85.6	85.8
WASH	548.5	76.9	98.2	129.5	122.8	132.1	213.0	215.0	14.0	17.9	23.6	22.4	24.1	38.8	39.2
WEST	655.4	215.5	242.1	302.7	239.1	317.1	354.7	362.7	32.9	36.9	46.2	36.5	48.4	54.1	55.3
TOTAL	8831.6	3826.2	3874.0	4339.9	4346.5	4825.5	5660.3	5734.6	43.3	43.9	49.1	49.2	54.6	64.1	64.9

SOURCES: Adapted from data in Illick (28); Pa. Dept. of Forests and Waters (29); U.S. Forest Service (30); Soil Conservation Service (31).

FIGURE 2.1.4. - 4
PERCENT OF COUNTY LAND
IN THE FORESTED CONDITION
PENNSYLVANIA ORBES REGION - 1974


- ≥ 80%
- 70 - 79%
- 60 - 69%
- 50 - 59%
- < 50%
MERC
LAWR
BEAV
BUTL
CLAR
JEFF
ARMS
INDI
ALLE
WEST
CAMB
WASH
GREE
FAYE
SOME

Source: Adapted from data in Table 2.1.4. - 4 dominated, whereas moist slopes and gentle river valleys are mixed mesophytic or occasionally beech-maple. The hemlock-hardwood association can still be found on steep ravines and plateau summits (32).

The Allegheny, Monongahela, and Ohio Rivers course through a belt of low hills. The flood plain and riparian vegetation cradled by these hills includes: silver maple, willow, sycamore, American elm, sweet gum, cottonwood, and river birch. Patches of alder and bands of red maple are also important constituents. Secondary growth stands are comprised of beech, white oak, black oak, and hickory. The old valley flatland areas are forested with pin oak, sweet gum, and red maple. The dry sections of this flatland contain considerable numbers of tulip tree, white oak, and beech. The developmental sequence for the remnants of the primary communities appears to be as follows:

pin oak → sweet gum → red maple →
beech → red maple → sweet gum →
beech (33, 34).

The upland areas along the Ohio River are typically dominated by oak-hickory associations. The same situation is true of such areas along the middle and lower reaches of the Allegheny and Monongahela Rivers.

The land surrounding the headwaters of the Allegheny River is dominated by northern hardwood species. Similarly, the drainage basins of the major tributaries are vegetated with typical species of the Northern Hardwood Forest Association (K106). Yellow birch and sugar maple are common. Tulip trees are frequently encountered on the southern range of the Allegheny Plateau and Mountains. Secondary oak stands are common around the periphery of the plateau. Although the northern forest of this region has been modified by lumbering activities and the intrusion of more southern tree species, the original forest in Cook Forest State Park has been preserved. This large, virgin forest borders the Clarion River and contains approximately equal numbers of white pine and hemlock. This primeval forest association has been designated as a national natural landmark by the National Park Service.

Lumbering and other human activities have eliminated much of the Mixed Mesophytic Forest Association (K103) from our area. Tracts of land in the vicinity of the Upper Monongahela River, in addition to the eastern slope and valleys of the Allegheny Front, support remnant examples of this association. Ohiopyle State Park along the Upper Youghiogheny River contains an especially representative example of the mixed mesophytic type. A hemlock-white pine-northern hardwoods association also exists in the Ohiopyle region; it intergrades and interfingers with the more southern mesophytic forest. This mixing and interdigitation of forest types is more characteristic of our middle and southern latitudes, where the north-south trends in mountain ridges and valleys induce relative uniformity in climate and soil types. Individual plant species and entire forest associations thereby have access to a continuous migratory route (6, 9).

Commercial forest lands consist of those areas which: (a) are producing, or are potentially capable of producing, usable crops of wood; (b) are economically available now or prospectively; and (c) are not withdrawn from timber utilization. This definition encompasses the overwhelming majority of all forested land in Pennsylvania. Indeed, approximately 98% of all forested land within Pennsylvania ORBES region is deemed to be commercial forest (21). The ownership of commercial forest lands within the Pennsylvania ORBES region is delineated in Table 2.1.4.-5. Table 2.1.4.-6 describes the principal tree associations which occur on our commercial forest lands within each of the nineteen Pennsylvania ORBES counties. Table 2.1.4.-7 quantitatively distributes these association types within each of the nineteen Pennsylvania ORBES counties. A simplified overview of modern association dominance is presented in Figure 2.1.4.-5.

F. Herbaceous Flora of the Forest

Irrespective of association type, the mature forests of our region are characterized by an almost continuous crown cover with little solar radiation reaching the forest floor. Consequently, understory shrubs and herbs undergo maximal growth during the spring. Magnificent woodland flowers such as spring beauty, trillium, hepatica, anemone, and violets are typical woodland flowers. Flowering shrubs such as azalea, mountain laurel, and rhododendron are also aesthetic treasures of this region. Many of our flowering plants are currently on the endangered species list (Table 2.1.4.-8). This is especially true of the orchids (Family Orchidae).

G. The Field Community

The clearing of Pennsylvania's forests for agriculture established numerous grasslands and fields during the last century, especially in the counties of Somerset, Butler, Washington, Westmoreland, Mercer, and Indiana. Herbaceous species such as goldenrods (Solidago) and other members of the aster family, which prefer open, sunny areas, are believed to be more abundant today than in pre-settlement times. Dewberries and black raspberries (Rubus) are also characteristic of our field communities. These fruits serve as food for a wide variety of wildlife. However, the overwhelming majority of Pennsylvania's grasslands and fields are merely transitional communities which, if left undisturbed, will eventually revert to secondary woodland.

H. Endangered Plant Species

"The Endangered Species Act of 1973" (PL 93-205) directed

TABLE 2.1.4.-5

OWNERSHIP[1] OF COMMERCIAL FOREST LANDS IN ORBES-PENNSYLVANIA

(thousands of acres)

COUNTY	ST. FOR.	GM. LAND	NAT. FOR.	FOR. IND.[2]	FARM[3]	OTHER	T.C.F.A.
ALLE	0	1.1	0	0	8.0	163.4	172.5
ARMS	0	2.0	0	0.5	35.2	172.3	210.0
BEAV	0	1.3	0	0	20.5	104.5	126.3
BUTL	0	2.0	0	0	35.6	215.1	252.7
CAMB	0.2	17.3	0	9.6	36.8	214.4	278.3
CLAR	0	11.0	0	17.4	45.8	184.1	258.3
CLEA	74.2	24.7	0	12.7	35.1	430.5	577.2
ELK	66.1	59.6	113.3	45.7	12.8	178.6	476.1
FAYE	14.5	10.9	0	0.7	42.3	248.3	316.7
FORE	2.1	7.8	110.6	33.4	7.1	92.3	253.3
GREE	0	3.4	0	0.1	40.6	140.9	185.0
INDI	0.5	4.6	0	1.3	57.4	217.6	281.4
JEFF	8.7	22.8	0	12.2	31.6	232.1	307.4
LAWR	0	1.0	0	0	17.7	71.5	90.2
MERC	0	0.8	0	0.2	53.2	105.4	159.6
SOME	26.1	17.2	0	8.5	110.0	275.3	437.1
VENA	0	15.3	0	22.7	32.6	284.5	355.1
WASH	0	2.1	0	0.2	44.3	173.5	220.1
WEST	3.4	9.5	0	0.4	43.1	252.6	309.0
19 County Total	195.8	214.4	223.9	165.6	709.7	3756.9	5266.3

St. For. = State Forests; Gm. Land = Game lands; Nat. For. = National Forest; For. In. = Forest Industry; T.C.F.A. = Total Commercial Forest Acreage.

1. 1964-1967

2. For. In. = 35% pulpmills, 37% sawmills and 28% wood-using industry (exclusive of logging) on a state-wide basis.

3. 1964 Census of Agriculture

SOURCE: Pa. Dept. of Commerce (21)

TABLE 2.1.4.-6

DEFINITIONS OF FOREST COVER TYPES APPEARING IN TABLE 2.1.4.-7

White pine: Forests in which 50 percent or more of the stand is eastern white pine. In Pennsylvania, this includes a small acreage in the hemlock type.

Virginia-pitch pine: Forests in which 50 percent or more of the stand is Virginia pine, pitch pine or other yellow pines, singly or in combination. Includes small areas of the spruce forest type.

Oak-hickory: Forests in which 50 percent or more of the stand is upland oaks or hickory, singly or in combination except where pines comprise 20 to 49 percent, in which case the stand would be classified oak-pine. It also includes the yellow poplar - oak forest type.

Other oak types: Primarily oak-pine and oak-gum forests. Those forests in which 50 percent or more of the stand is hardwood, usually upland oak, but in which pines make up 25 to 49 percent of the stand are categorized as oak-pine. Oak-gum forests are bottomland types in which 50 percent or more of the stand is blackgum, sweetgum, or oaks, singly or in combination, except where pines comprise 25-49 percent.

Elm-ash-red maple: Forests in which 50 percent or more of the stand is American elm, black ash or red maple, singly or in combination. When all three species are present, this signifies a wet site. In Pennsylvania predominantly red maple stands on upland sites make up most of the acreage in this broad type.

Maple-beech-birch: Forest in which 50 percent or more of the stand is sugar maple, beech or yellow birch, singly or in combination. It includes the black cherry forest type.

Aspen-birch: Forests in which 50 percent or more of the stand is aspen, paper birch, gray birch, or pin cherry, singly or in combination.

TABLE 2.1.4.-7

ORBES - PENNSYLVANIA COMMERCIAL FOREST COMPOSITON BY TREE ASSOCIATION[1]

County	T.C.F.A.[2] (thousand acres)	% White pine	% Pitch-Virginia Pine	% Oak-Hickory	% Other Oaks	% Elm-Ash Red Maple	% Maple Beech-Birch	% Aspen-Birch
Alle	172.5	4.4	0.8	26.7	2.4	22.2	16.6	26.9
Arms	210.0	4.9	0.7	29.7	2.0	24.6	18.1	20.0
Beav	126.3	4.7	0.6	27.9	1.9	23.0	19.5	22.5
Butl	252.7	4.8	0.7	28.7	1.9	24.1	19.7	20.1
Camb	278.3	2.1	1.0	55.7	5.1	9.7	21.8	4.6
Clar	266.7	8.4	4.5	52.5	1.8	6.6	9.6	1.6
Clea	585.9	6.8	2.3	59.4	1.3	8.8	12.3	9.2
Elk	471.6	4.9	---	20.8	0.8	12.1	47.7	13.7
Faye	316.7	2.5	1.5	55.3	5.7	9.1	20.1	5.7
Fore	251.6	4.9	---	19.1	3.0	11.4	50.0	11.6
Gree	185.0	4.6	0.9	27.1	2.6	22.3	19.7	22.7
Indi	281.4	4.9	0.8	29.6	2.2	24.2	18.5	19.7
Jeff	315.6	9.9	3.5	54.1	1.5	7.8	9.4	13.8
Lawr	90.2	4.5	0.6	27.7	1.7	23.3	18.7	23.5
Merc	159.6	4.2	0.9	24.9	2.8	20.7	18.1	28.4
Some	437.1	2.3	1.6	52.2	5.6	8.3	24.3	5.7
Vena	361.5	9.3	2.4	55.3	1.4	9.6	10.2	11.8
Wash	220.1	4.4	0.6	24.7	1.8	20.1	21.7	26.7
West	309.0	4.9	0.6	30.1	1.9	24.1	18.0	20.4
19 County TOTAL	5291.2	5.3	1.4	40.2	2.5	14.6	21.3	14.9

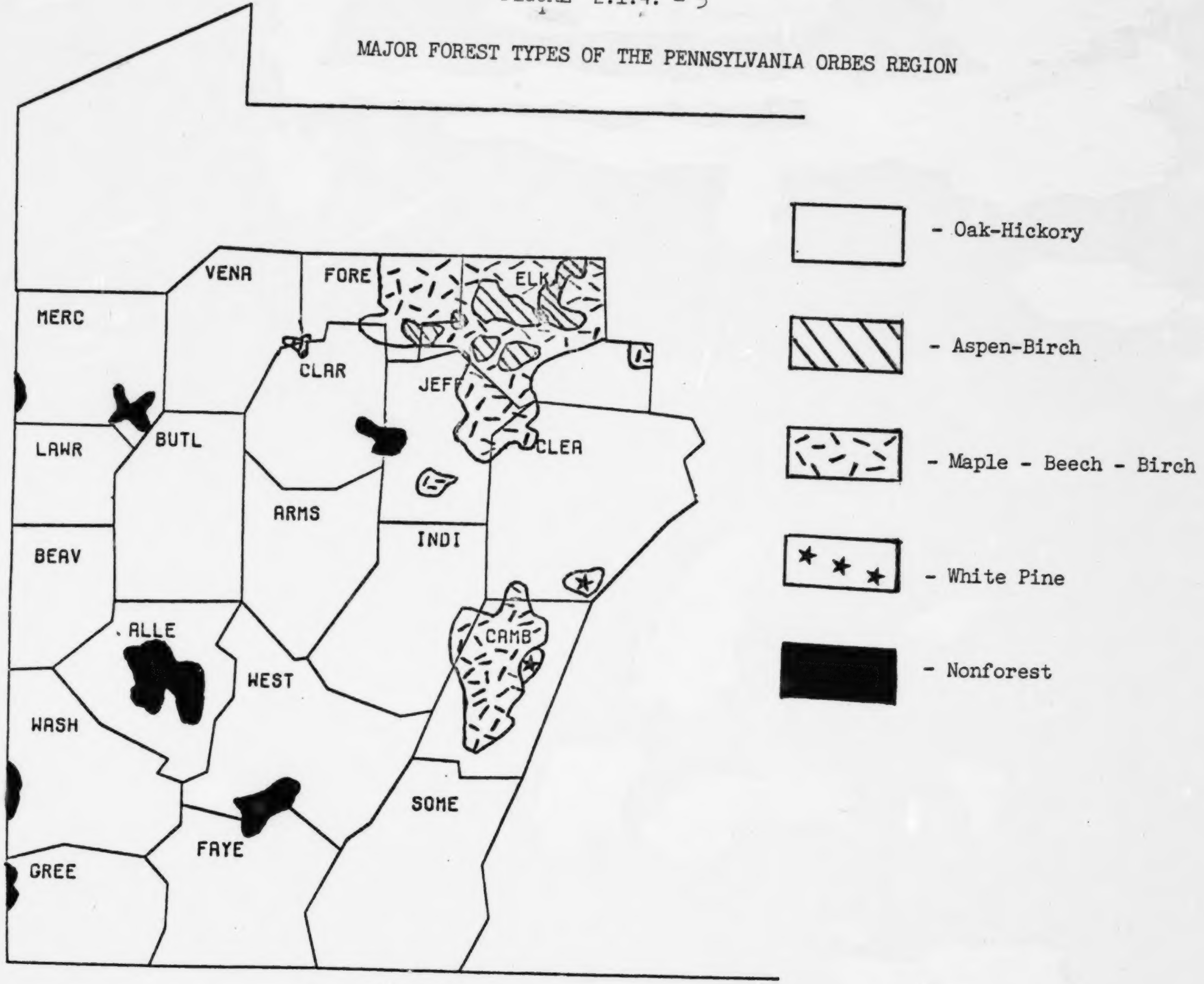
1. Percentage of county-specific, total commercial forest land (1965) occupied by the given tree association. Percentages may not add to one hundred due to rounding of figures.

2. T.C.F.A. Total Commercial Forest Acreage for 1965. Substantial increases in the amount of forested land within the Pennsylvania ORBES region have occurred during the past decade. For a more recent estimation of T.C.F.A. see Table 2.1.4.-4 (commercial forest lands typically comprise over 99% of the estimated forest acreage).

SOURCE: Adapted from Ferguson (25).

FIGURE 2.1.4. - 5

MAJOR FOREST TYPES OF THE PENNSYLVANIA ORBES REGION


VENA
FORE
ELK
MERC
CLAR
JEFF
LAWR
BUTL
CLEA
ARMS
BEAV
INDI
ALLE
CAMB
WEST
WASH
SOME
FAYE
GREE
- Oak-Hickory
- Aspen-Birch
- Maple - Beech - Birch
- White Pine
- Nonforest

SOURCE: Adapted from U.S. Forest Service (35).

TABLE 2.1.4.-8

ENDANGERED AND THREATENED PLANT SPECIES IN THE STATE OF PENNSYLVANIA

Status	Specific Name	Common Name	Habitat Preference
Endangered	*Cerastium arvense* var. *villosissimum*	Long-hairy field Chickweed	Serpentine barrens
Endangered	*Isotria medeoloides*	Small whorled Pogonia	Acid soil in dry woods
Endangered	*Potamogeton Porteri*	Porter's pondweed	Shallow water
Endangered	*Trollius laxus*	Spreading globe-flower	Swamps, wet woods and wet meadows
Endangered*	*Scirpus ancistrochaetus*	Bulrush	Bogs
Threatened	*Echinacea laevigata*	Smooth purple coneflower	Woods and prairies
Threatened	*Juncus gymnocarpus*	Naked-fruited rush	Sphagnum bogs
Threatened	*Cypripedium candidum*	Small white lady's slipper	Calcareous sails of marly bogs, open swamps and wet prairies
Threatened	*Platanthera peramoena*	Purple fringeless orchid	Damp or wet soil
Threatened	*Calamagrostis Porteri*	Porter's reed-bentgrass	Wet rocks and sandy shores
Threatened	*Muhlenbergia curtisetosa*	Short-bristled Muhly grass	Moist, shady ground
Threatened	*Poa paludigena*	A meadow grass	Bogs and wet woods
Threatened	*Asplenium ebenoides*	Walking spleenwort	Woods banks and rocks in circumneutral soil
Threatened	*Potamogeton Hillii*	Hill's pondweed	Shallow water
Threatened	*Prunus alleghaniensis*	Sloe; Allegheny plum	Dry, rocky woods

(TABLE 2.1.4.-8 Cont.)

Status	Specific Name	Common Name	Habitat Preference
Threatened	Micranthemum micranthemoides	Lettuce-leaved saxifrage; Mountain lettuce	Muddy shores between estuary tide-marks

SOURCES: -Species after Smithsonian Institution (36).
-Habitat Preferences after Gleason and Cronquist (37).

*Revisions as of May 21, 1975; see Federal Register (38).

the Smithsonian Institution to prepare a list of endangered and threatened plant species. The term "endangered" denotes those species of plants in danger of extinction throughout all or a significant portion of their ranges. Plant taxa from very limited areas (e.g., type localities) or from restricted fragile habitats are usually considered endangered. Threatened species are those species that are likely to become endangered within the foreseeable future throughout all or a significant portion of their ranges. This includes species categorized as rare, very rare, or depleted. Table 2.1.4.-8 presents a list of endangered and threatened plant species for the State of Pennsylvania with notations on the preferred habitat of these species.

The compilation of an endangered and threatened species list has gained new impetus in recent years and the potentiality exists for additions to the list in the near future. Table 2.1.4.-9 lists species which are rare in western Pennsylvania, have been found in Pennsylvania ORBES counties, but have not yet received official, threatened status. Likewise, Table 2.1.4.-10 lists species which are rare in western Pennsylvania, have been found in counties that neighbor the ORBES region, but have not yet been designated as threatened.

It is evident from these tables that the majority of endangered, threatened, or rare species are small, flowering plants native to moist or wet areas. Pine, serpentine, and shale barrens also support a significant number of such species.

I. Beneficial Aspects of Natural Vegetation

The precise monetary value of our botanic communities is unquantifiable, yet indisputably astronomical. Plants, either directly or indirectly, serve as the food source for virtually all heterotrophic organisms. Furthermore, the plants of fragile, ecosystems may serve as valuable indicator organisms, "sounding an alarm" to man in the event of environmental perturbations. Forests, woodlots, and fields serve as living and breeding places for our wildlife. Pennsylvanians have utilized particular species for timber and fiber for centuries. Modern man is equally dependent upon natural areas as aesthetically appealing places for seeking tranquility or pursuing outdoor-based recreation. In addition, well managed forests are extremely valuable entities within the framework of the hydrologic cycle. Such forests tend to control soil erosion and, therefore, promote good water quality.

The multiple benefits associated with our forests can be best insured by wise management and the preservation of species diversity within the various community types. The Smithsonian Institution (36) has rendered the following justification for this strategy.

TABLE 2.1.4.-9

RARE PLANTS* OF THE PENNSYLVANIA 19-COUNTY ORBES REGION

Specific Name	Common Name	Location where found	Habitat Preference
Aconitum reclinatum grey	Trailing wolfsbane	Wymp's Gap, Fayette Co.	Mountain woods
Aster lineariifolius L.	Linear-leaved Aster	Ohiopyle, Fayette Co.	Dry ground & open woods; esp. sandy soil
Carex fraseri Andr. (= *Cymophyllus*)	Fraser's Sedge	Reel's Corners, Somerset Co.	Rich mountain woods
Clethra acuminata Michx.	Mountain Sweet pepperbush	Elliotsville, Fayette Co.	Rich mountain woods
Croton glandulosus var. *septentrionalis* Mvell. Arg.	Glandular Croton	Bidwell, Fayette Co.	Dry or sandy soil
Eleocharis rostellata Torr.	Small-beaked spike-rush	Lawrence Co.	Saline or calcareous swamps and marshes; esp. along coast
Gentiana flavida Gray	Yellowish Gentian	Ribold to Renfrew, Butler Co.	Moist, open woods
Gentiana saponaria L.	Soapwort Gentian	Markleysburg Bog, Fayette Co.	Moist woods and thickets
Houstonia purpurea L.	Mountain Houstonia	Ohiopyle and Chalkhill, Fayette Co.	Dry woods , pine barrens and prairies
Iris prismatica Pursh	Slender Blue Flag	Ohiopyle floodplain, Fayette Co.	Sandy open woods & pine-lands
Magnolia tripetala L.	Umbrella Magnolia	Ohiopyle and Indian Creek, Fayette Co.	Rich woods
Marshallia grandiflora Beadle & F.E. Boynt	Barbara's - buttons	Ohiopyle, Fayette Co.	River banks and dry woods

(TABLE 2.1.4.-9 Cont.)

Specific Name	Common Name	Location where found	Habitat Preference
Polygala cruciata var. aquilonia Fern. & Schub.	Cross-leaved Milkwort var.	Chalkhill, Fayette Co.	Damp or wet soil; marshes and pine-barrens
Prenanthes racemosa Michx.	Great Lake Lion's-foot	Plaingrove Bog, Lawrence Co.	Stream banks, moist meadows
Samolus parviflorus Raf.	Water-pimpernel	Butler Co. (only 1 specimen collected)	Muddy stream banks & ditches
Stylosanthes riparia Kearney	Pencil-flower	Ohiopyle, Fayette Co.	Dry woods & barrens
Trillium cernuum var. macranthum Wieg	Nodding Trillium	Formerly grew @ Thornhill, Allegheny Co.	Moist or wet woods
Xyris torta J.E. Smith	Yellow-eyed Grass	Chalkhill Bog, Fayette Co.	Bogs & wet, esp. sandy soil

* These plants have been collected from only one Western Pennsylvania county.

Sources: -Species and their locations after Carnegie Museum Herbarium Records (39).

-Habitat preferences after Gleason and Cronquist (37).

TABLE 2.1.4.-10

RARE PLANTS* OF COUNTIES

NEAR THE PENNSYLVANIA ORBES REGION

Specific Name	Common Name	Location where found	Habitat Preference
Ammophila breviligulata Fern	Beachgrass	Presque Isle, Erie Co.	Dunes and dry sandy shores; along all Great Lakes and Atlantic
Arctostaphylus glaucophylla var. *latifolia* Rehd.	Bog-rosemary	Sulfur Springs Bog, Warren Co.	Acid Bogs
Arctostaphylus uva-ursi var. *adenotricha* Fern. & Macbr.	Bearberry	Presque Isle, Erie Co.	Sandy or rocky soil
Botrychium multifidum (Gmel.) Rupr.	Leathery Grape-fern	Wattsburg, Erie Co.	Open, often moist and sandy places, rarely in woods
Butomus umbellatus L.	Flowering Rush	Escaped along Elk Creek and Presque Isle, Erie Co.	Shores and river banks along St. Lawrence River Valley and some stations along Great Lakes
Cakile edentula var. *lacustris* Fern.	Scurvy-weed	Presque Isle, Erie Co.	Coastal sands
Chrysogonum virginianum L.	Chrysogonum	Warfordsburg, Fulton Co.	Woodland
Conioselinum chinense (L.)	Hemlock-parsley	Laurel Springs & Spruce Creek, Huntingdon Co.	Swamps, bogs, wet ledges and wet meadows
Diarrhena americana Beauv.	Twin grass	Bedford Co.	Moist woods
Eriocaulon septangulare Withering	Seven-angled pipewort	Canadohta Lake, Crawford Co.	Usually shallow water, occasionally in deep water or on miry shores
Eriophorum spissum Fern.	Hare's-tail	Titus Bog, Erie Co.	Bogs and wet soil

(TABLE 2.1.4-10 Cont.)

Specific Name	Common Name	Location where found	Habitat Preference
Gerardia auriculata Michx.	Auricled Gerardia	Tonoloway Creek, Fulton Co.	Prairies or open upland woods
Habenaria leucophaea (Nutt.)	Prairie white-fringed orchid	Harmonsburg, Crawford Co.	Wet praries, bogs, marshes
Heteranthera reniformis R.&P.	Mud plantain	Lutzville, Bedford Co.	Submersed, floating or creeping in mud
Hibiscus palustris L.	Rose mallow	Presque Isle, Erie Co.	Salt marshes along coast
Iris verna var. smalliana Fern.	Upland violet Iris	Big Tonoloway Creek, Fulton Co.	Sandy soil, coastal barrens. piedmont, mountains.
Juncus alpinus var. rariflorus Hartm.	Alpine rush	Presque Isle, Erie Co.	Wet meadows and sandy or gravelly shores
Juncus balticus var. littoralis Engelm.	Baltic rush	Presque Isle, Erie Co.	Calcareous or brackish shores and dunes and also inland
Ledum groenlandicum Oeder	Labrador tea	Sulphur Springs Bog, Warren Co.	Bogs and wet shores
Ligusticum canadense (L.) Britt	Angelico	Breezewood, Bedford Co.	Woods, chiefly in the mountains
Listera australis Lindl	Southern Twayblade	Sulphur Springs and Toplovich Bogs, Warren Co.	Shaded bogs and wet woods
Lonicera villosa var. tonsa Fern.	Mountain fly-honeysuckle	Toplovich Bog, Warren Co.	Swamps and wet woods
Pachistima Canbyi Gray	Canby's mountain-lover	Lutzville, Bedford Co.	Rocky woods in the mountains
Pinus echinata Miller	Short-leaved pine	Shale barrens in Fulton Co.	Dry, sandy, or rocky soil
Potentilla anserina L.	Silverweed	Presque Isle, Erie Co.	Wet, sandy beaches

(TABLE 2.1 .4-10 Cont.)

Specific Name	Common Name	Location where found	Habitat Preference
Prenanthes serpentaria Pursh	Lion-foot	Bedford Springs, Bedford Co.	Woods
Pseudotaenidia montana Mackenzie	False pimpernel	Hewitt, Bedford Co.	Shale-barrens
Salix candida Flugge	Hoary willow	Presque Isle, Erie Co.	Cold bogs and glaciated areas
Salix glaucophylloides var. albovestita (Ball) Fern.	White-haired willow	Presque Isle, Erie Co.	Sandy shores, calcareous slopes and sometimes swamps
Scheuchzeria palustris var. americana Fern.	Scheuchzeria	Titus Bog, Erie Co.	Cold sphagnum bogs
Senecio antennariifolius	Cat's-paw ragwort	Harrisonville, Fulton Co.	Shale-barrens
Shepherdia canadensis (L.) Nutt	Soapberry	Elk Creek and shores of Lake Erie, Erie Co.	Dry, sandy or stony, calcareous soil
Sida hermaphrodita (L.) Rusby	Virginia mallow	Saxton, Bedford Co.	Moist alluvial soil
Sparganium minimum Fries	Least Bur-reed	Presque Isle, Erie Co.	In shallow water
Spiraea corymbosa Raf.	Flat-topped Spiraea	Clearville, Fulton Co.	Mountain woods
Triglochin palustris L.	Marsh arrow-grass	Presque Isle, Erie Co.	Brackish marshes along the coast and in bogs
Utricularia resupinata B.D. Greene	Purple bladderwort	Presque Isle, Erie Co.	Muddy soil or very shallow water at edge of ponds
Zizania aquatica var. angustifolia Hitchc.	Northern wild rice	Presque Isle, Erie Co.	Marshes, stream banks and shallow water

* These plants have been collected from only one Western Pennsylvania County.

Sources: -Species and their locations after Carnegie Museum Herbarium Records (39)

-Habitat Preferences after Gleason and Cronquist (37).

> A wide variety of plant species is essential to the maintenance of the environment in a livalbe condition in order to prevent wind and water erosion and to aid in developing fertile soil, in storing water, and in maintaining or providing subsurface water. A wide diversity of plant species and populations, therefore, is required to stock the many different habitats and ecosystems of the earth and is necessary to maintain ecological stability. Man's own monocultural system of agriculture has taught him much about the problems of ecological stability in the need for protection from diseases, insect pests, weeds, depletion of soil nutrients, and similar ecological problems. ... A large untapped potential of enormous value to man exists if he preserves the diversity of plant species. It has been estimated that 50,000 new alkaloids can be discovered in plants, including possible cancer cures. New plant medicinals and drugs are presently being discovered.

The mere presence of a dense forest canopy above a land mass serves to reduce the erosive force of rainfall. Furthermore, the thick mats of leaf litter and humus, so typical of Pennsylvania's deciduous forest floors, effectively absorb and retain significant quantities of precipitation. These processes reduce runoff and erosion; consequently, they regulate stream flow and limit siltation. Table 2.1.4. - 11 depicts the substantially reduced capacity of harvested forest lands for erosion control. Field studies have indicated that roads used to access logging sites are probably more responsible for this diminished erosion-control capacity than the actual removal of trees (41). However, managed forests in western Pennsylvania have been shown to be substantially less erodible than their unmanaged counterparts (see Table 2.1.4. -12). The "Copeland Report" (43) noted that the hydrology and water quality of most of western Pennsylvania is influenced to a major degree by the forests of the area

Forested lands enhance water quality in several additional ways. Canopy cover often shades cold water streams from direct solar radiation, thereby inhibiting temperature increases and algae blooms. The autumnal leaf-drop "powers" the bioenergetics of the aquatic communities inhabitating woodland streams. Furthermore, the biomass of our terrestrial vascular plants acts as a storage reservoir within the hydrologic cycle that is not easily polluted by man. Unfortunately, indiscriminate land clearing, heavy livestock grazing, and poor lumbering practices have left approximately one-third of western Pennsylvania in poor hydrologic condition. Essentially all (95%) of Pennsylvania's forested land has a high to medium potential for hydrologic improvement (44).

TABLE 2.1.4 - 11

REPRESENTATIVE EROSION RATES FOR VARIOUS LAND USES

Cover type	Soil Loss Tons/Acre/Year
Forest	0.0375
Grassland	0.375
Abandoned Surface Mines	3.75
Cropland	7.50
Harvested Forest	18.75
Active Surface Mines	75.00
Construction	75.00

Source: U.S. Environmental Protection Agency (40)

TABLE 2.1.4. - 12

1974 LAND USE AND CALCULATED* EROSION RATES IN WESTERN PENNSYLVANIA

		LAND USE (%)				SHEET AND RILL EROSION RATES (tons/acre/year)				
							Forest			
Pa. DER Sub-basin	Acreage[1] (millions of acres)	Cropland	Pasture	Forest	Other	Cropland	Managed	Unmanaged	Pasture & Other Land	Weighted Average
#16 (Upper Allegheny River Basin in Pa.)	2.375	16	6	74	4	3.4	0.4	7.2	2.9	1.2
#17 (Middle Allegheny River Basin)	1.607	16	4	75	5	3.9	0.5	9.2	4.2	1.8
#18 (Lower Allegheny River Basin)	1.347	22	5	61	12	3.8	0.5	9.2	5.2	2.3
#19 (Monongahela River Basin in Pa.)	1.521	20	10	56	14	6.5	0.5	10.1	5.4	3.4
#20 (Upper Ohio-Beaver River Basin in Pa.)	1.564	28	12	46	14	3.8	0.4	7.8	5.4	2.9

*Calculated using the universal soil-loss equation (USLE)

1. Acreage of sub-basin after federal land, urban land, built-up areas, and large water areas are deducted from the total area of the sub-basin.

SOURCE: Adapted from Pennsylvania Department of Environmental Resources (42).

2.1.4.2 VERTEBRATE FAUNA

A.) Amphibians and Reptiles

The great diversity of Pennsylvania's "herpetofauna" has classically been attributed to the presence of the Appalachian Mountains and three large river basins; these physiographic features provide a variety of suitable habitats throughout the Commonwealth. On a statewide basis, Netting and Richmond (45) indicate that seventy-six different species* of reptiles and amphibians have been recorded over the years. More than two-thirds of this total have been observed within the confines of the Pennsylvania ORBES region (46, 47, 48).

Although the physiographic features of the Commonwealth do not function as exceptionally strong distributional barriers, Reinert and Dalby (49) have noted the following generalized zoogeographic patterns:

I. A southern element of the Nearctic herpetofauna has penetrated the southeastern portion of the state, inhabiting the lowland and coastal plain region.

II. Another southern element has penetrated part, or all, of the Appalachian mountain system but has not been successful on the more westerly Appalachian Plateaus (Pa. ORBES region).

III. A western element of the Nearctic herpetofauna, consisting of a smaller number of species has entered the Appalachian Plateaus (Pa. ORBES region) but has had little success in penetrating the Appalachian Mountains.

However, these distributional patterns are "givens" in any environmental analysis (i.e. they are "part and parcel" of the ecological framework imposed by nature and evolution). Currently, the most dramatic influences on reptile and amphibian distribution within the Pennsylvania ORBES region arise from the activities of man. The Army Corps of Engineers (33, 34) summarize the most important distributional trend as follows, "As might be expected, the number of species and suitable habitats increases with distance from Pittsburgh and its associated urbanization, industrialization, and environmental pollution."

None of Pennsylvania's herpetofauna are currently included on the "Federal Endangered Species List" (50). The bog turtle (_Clemmys muhlenbergi_) was formerly listed but has recently been dropped from the list.** However, the Pennsylvania Fish Commission issues its own "List of Endangered, Threatened, or Status Indeterminant Amphibians and Reptiles" (see Table 2.1.4. - 13) which includes the bog turtle and seventeen other species of herps. Authority for the protection of Pennsylvania herpetofauna rests primarily with the Fish Commission. The annually published "Summary of Fishing Regulations and Laws" (52) outlines the laws regulating the possession of particular species.

---

*This total is comprised of 21 salamanders, 15 frogs and toads, 4 lizards, 14 turtles, and 22 snakes.

**New evidence suggests that this turtle may merely be behaviorally secretive and not actually endangered.

Inasmuch as no extensive inventory of Pennsylvania's herpetofauna has ever been undertaken, the quantification of any past impacts is tenous. The herpetological records indicate that several currently rare species (Blanding's turtle, midland smooth softshell turtle, and Kirtland's water snake) were probably never exceedingly common in western Pennsylvania (53). Nonetheless, impacts on other species have indeed occurred since the herpetological records once indicated a high diversity in Allegheny County (48) and such is obviously not the case today. Conversely, certain species of herps seem to be quite compatible with civilization. Species still relatively common in Allegheny County include: American toad (*Bufo a. americanus*), garter snake (*Thamnophis s. sirtalis*), black rat snake (*Elaphe o. obsoleta*), milk snake (*Lamphropeltis t. triangulum*), northern dusky salamander (*Desmognathus f. fuscus*), red-backed salamander (*Plethodon c. cinereus*), and eastern box turtle (*Terrapene c. carolina*) (54).

The following four species of herps merit special consideration by virtue of their present status within the Pennsylvania ORBES region.

1. Massasauga (*Sistrurus catenatus*)

In the Pennsylvania ORBES region the massasauga (a prairie rattlesnake) occurs chiefly in wet meadows, although it may also inhabit bogs, swamps, and even dry woodlands (32, 46, 47). The literature (55) suggests that this snake, at least during the last century, never was exceedingly common in the Pennsylvania ORBES region. Nonetheless, natural succession and habitat destruction by man via the damming and draining of wetlands have served to make this rare species even more scarce in recent years (56, 57). Persecution by people who dislike snakes, especially poisonous ones, has doubtlessly intensified the problem (57). Consequently, the massasauga is currently labeled an endangered species by the Pennsylvania Fish Commission (see Table 2.1.4.-13). Although records of their occurrence exist for four Pennsylvania ORBES counties, at the present time known massasauga populations are essentially confined to areas near Slippery Rock (see Appendix, Natural Area #35) and Bruin in Butler County, in addition to Five Points in Venango County (58). Individuals have also been reported from the Pymatuning area in Crawford.*

---

*Crawford County is not a Pennsylvania ORBES County but it is drained by the Upper Ohio River system.

TABLE 2.1.4. - 13

PENNSYLVANIA FISH COMMISSION
LIST OF ENDANGERED (1), THREATENED (2) OR STATUS INDETERMINATE (3) AMPHIBIANS AND REPTILES

Common Name	Scientific Name	Status
+Blanding's turtle	Emydoidea blandingii	1
*Eastern mud salamander	Pseudotriton m. montanus	1
*Eastern tiger salamander	Ambystoma t. tigrinum	1
*New Jersey chorus frog	Pseudacris triseriata kalmi	1
*Southern plain leopard frog	Rana sphenocephala	1
*Eastern mud turtle	Kinosternon s. subrubrum	1
*Red-bellied turtle	Chrysemys rubriventris	1
*Broad-headed skink	Eumeces laticeps	3
*Eastern kingsnake	Lampropeltis g. getulus	3
Coal skink	Eumeces anthracinus	3
Green salamander	Aneides aeneus	2
Bog turtle	Clemmys muhlenbergi	1
Midland smooth softshell	Trionyx m. muticus	1
Kirtland's water snake	Clonophis kirtlandi	3
Eastern hognose snake	Heterodon platyrhinos	3
Rough green snake	Opheodrys aestivalus	3
Timer rattlesnake	Crotalus horridus	3
Massasauga	Sistrurus catenatus	1

Status categories are defined as follows:

1. Endangered: Actively threatened with extinction in the state. Continued survival unlikely without special protective measures.

2. Threatened: Not under immediate threat of extinction in the state, but occurring in such small numbers and/or in such restricted habitat that it could quickly cease to be a part of the state fauna.

3. Indeterminate: Apparently threatned or uncommon to rare, but insufficient data currently available on which to base a reliable assessment of status.

+Collected in Crawford County which is not a PA ORBES County but is drained by the Ohio River System.

*Based upon the herpetological records of the past (45,48), such species are not deemed to be likely inhabitants of the PA ORBES region.

Source: Adapted from PA Fish Commission (51); Netting and Richmond (45); and the U.S. Army Corps of Engineers (48).

2. Timber Rattlesnake (*Crotalus horridus*)

The timber rattlesnake inhabits rocky areas with a southern exposure in the more sparsely settled, mountainous counties of the Pennsylvania ORBES region. Although upland areas seem to be its preferred habitat, the timber "rattler" is known to descend into valleys to obtain water in the late summer (45). In the past, specimens have been recorded from ten of the nineteen Pennsylvania ORBES counties (see Fig. 2.1.4.-6); however, at the present time, significant populations within this area are probably confined to the northern section (Elk, Forest, Venango, Clarion, and Jefferson Counties) (58, 59). Consequently, the timber rattlesnake is currently listed as an indeterminate species by the Pennsylvania Fish Commission (see Table 2.1.4.-13).

The greatest threat to the continued survival of the timber rattlesnake within the Commonwealth is direct persecution by man. Pursuit of these "rattlers" was at one time encouraged by a bounty of one dollar per snake and past references describe lone snake hunters slaughtering hundreds of them in the northcentral portion of the state (55). At the present time, outdoorsmen and farmers may still kill them because of a fear and/or hatred of snakes, especially poisonous ones. Organized snake hunts for sport also occur in Pennsylvania and although the "rattlers" are usually released unharmed, a recent committee on reptile conservation (60) has recommended the prohibition of such hunts.

Timber rattlesnakes are known to congregate in rocky den areas, which often harbor numerous individuals, especially during hibernation. For this reason, they are particularly susceptible to impact from earth-moving activities within their preferred habitat.

3. Bog Turtle (*Clemmys muhlenbergi*)

The bog turtle is a small, semi-aquatic turtle which is currently categorized by the Pennsylvania Fish Commission as an endangered species (see Table 2.1.4.-13). The ruination of this turtle's preferred habitat (bogs and marshes) is thought to be the principle cause for its demise (58, 61). In addition, the scarcity of this reptile makes it a valuable "black market" item among exotic pet fanciers and herpetologists.

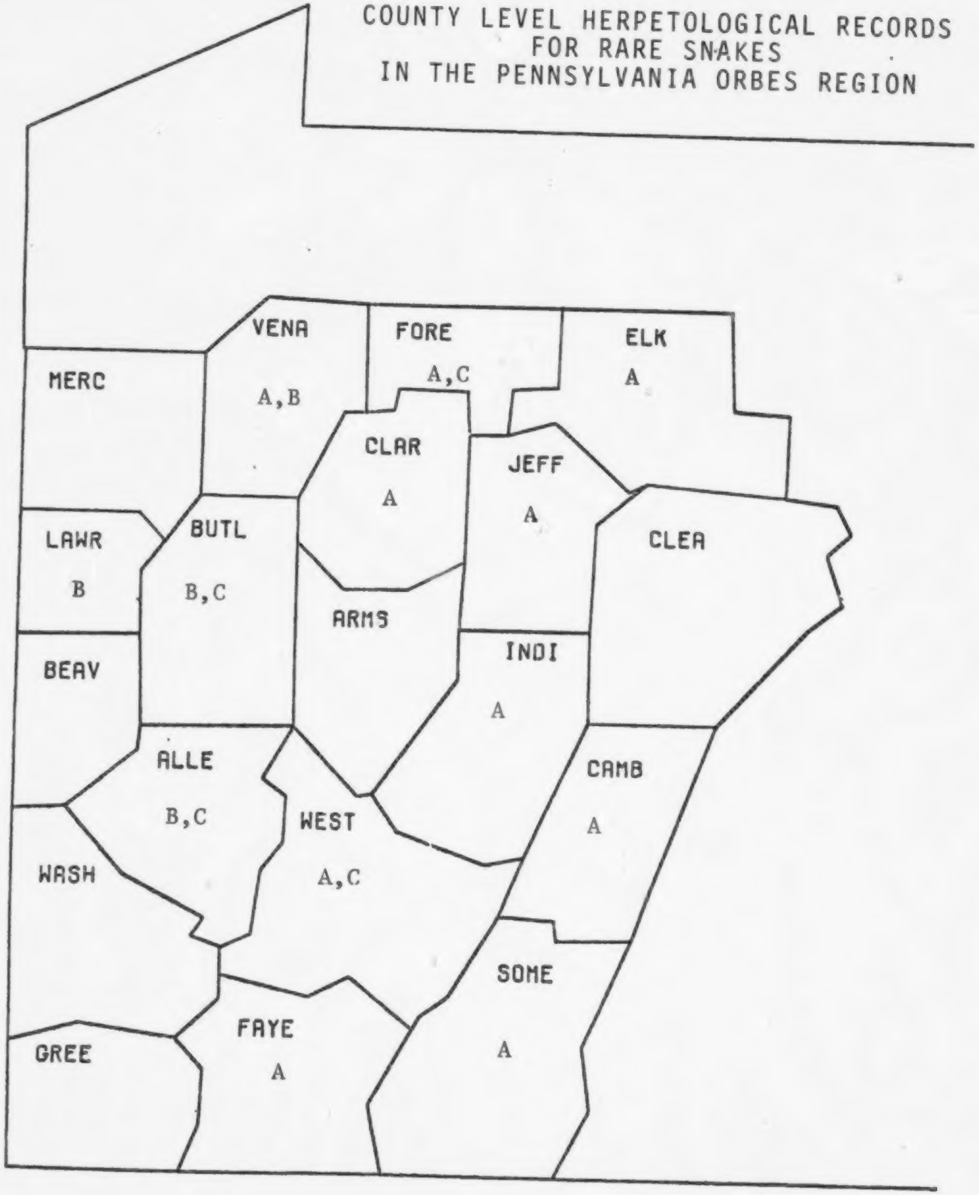
The bog turtle is believed to be very rare in the Pennsylvania ORBES region. Moreover, this turtle's secretive nature complicates efforts to locate and identify populations for special protection. Specimens have been reported from Mercer County (48) and Conneaut Marsh in Crawford County* (32).

---

*Crawford County is not a Pennsylvania ORBES county but it is drained by the Upper Ohio River system.

FIGURE 2.1.4.-6

COUNTY LEVEL HERPETOLOGICAL RECORDS
FOR RARE SNAKES
IN THE PENNSYLVANIA ORBES REGION


VENA
A,B
FORE
A,C
ELK
A
MERC
CLAR
A
JEFF
A
LAWR
B
BUTL
B,C
CLEA
ARMS
BEAV
INDI
A
ALLE
B,C
CAMB
A
WEST
A,C
WASH
SOME
A
FAYE
A
GREE

LEGEND

A. Timber Rattlesnake

B. Massasauga

C. Kirtland's Water Snake

SOURCE: U.S. Army Corps of Engineers (48).

4. Hellbender (Cryptobranchus alleganiensis alleganiensis)

This large, fully aquatic salamander is more properly discussed within the realm of aquatic ecology; however, it will be dealt with herein since amphibians, as a group, are typically thought of as terrestrial creatures.

At one time hellbenders inhabited swift, cool, and clear streams with rocky bottoms throughout the Pennsylvania ORBES region. Excavations of Indian Villages and the herpetological records of Carnegie Museum indicate that they were relatively common in and around Allegheny County (58). At the present time, hellbenders are hardly rare in the Pennsylvania ORBES region; however, their distribution has been substantially reduced. The effects of siltation, acid mine drainage, river impoundment, and thermal pollution have almost eliminated them from much of southwestern Pennsylvania (33, 34, 58). The largest remaining populations inhabit the clean watersheds to the north and east of Pittsburgh, especially the Upper Allegheny River, French Creek, and Loyalhanna Creek (58).

At a recent symposium on the status of nongame species within the Commonwealth (60), professional and amateur herpetologists discussed management strategies for the state's herpetofauna. The following recommendations summarize the essence of the outcome:

a.) Conservation of habitat-this would include, but not limit itself to, the acquisition of critical habitat and adjacent lands for endangered and threatened species.

b.) The undertaking of a statewide inventory of the herpetofauna.

c.) The prohibition of organized snake hunts.

d.) The establishment of bag and possession limits for all currently nonprotected species.

e.) Rewrite existing legislation in a more comprehensive manner in such a way as to give the Fish Commission more enforcement clout.

B. Avifauna

Trustworthy records of bird abundance and species composition are nonexistant for western Pennsylvania in pre-colonial and colonial times. Nonetheless, Todd (62) suspects that birds were more plentiful then and that forest species predominated. Indeed, the extensive forests of pre-settlement Pennsylvania could not have conceivably furnished suitable habitat to numerically significant populations of field species such as the bobolink, meadowlark, prairie horned lark, bobwhite, vesper sparrow, savannah sparrow, and grasshopper sparrow. These species undoubtedly entered the Pennsylvania ORBES region from the Mississippi Valley only after the agriculture and lumber industries had cleared substantial tracts of the virgin forest (see Section 2.1.4.1.-C).

Many ornithologists believe that atmospheric temperature is the primary ecological factor controlling the zoogeographic distribution of birds. Consequently, the life-zone concept of Allen (62) and Merriam (64) has often been applied to the Nearctic avifauna. This system divides North America into seven transcontinental belts of distribution, each of which is characterized by an assemblage of species. Figure 2.1.4.-7 maps the three life-zones that cross the Pennsylvania ORBES region. Table 2.1.4.-14 functions as a legend to this map by listing representative assemblages for each zone.

The Carolinian avifauna is comprised of typically southern species. In Pennsylvania, resident species belonging to this assemblage are believed to have their northernmost range limited by the severity of winter temperatures at higher latitudes. Altitudinal influence on temperature has impeded the colonization of the Allegheny Mountains by this group. Nonetheless, Todd (62) believes that these birds are numerically increasing and extending their occupied territory northward.

The Canadian avifauna is comprised of northern birds; however, in Pennsylvania this group contains few strictly boreal species. Moreover, changing forest conditions have resulted in a recession of Canadian species with an accompanying intrusion of the Alleganian avifauna from the south.

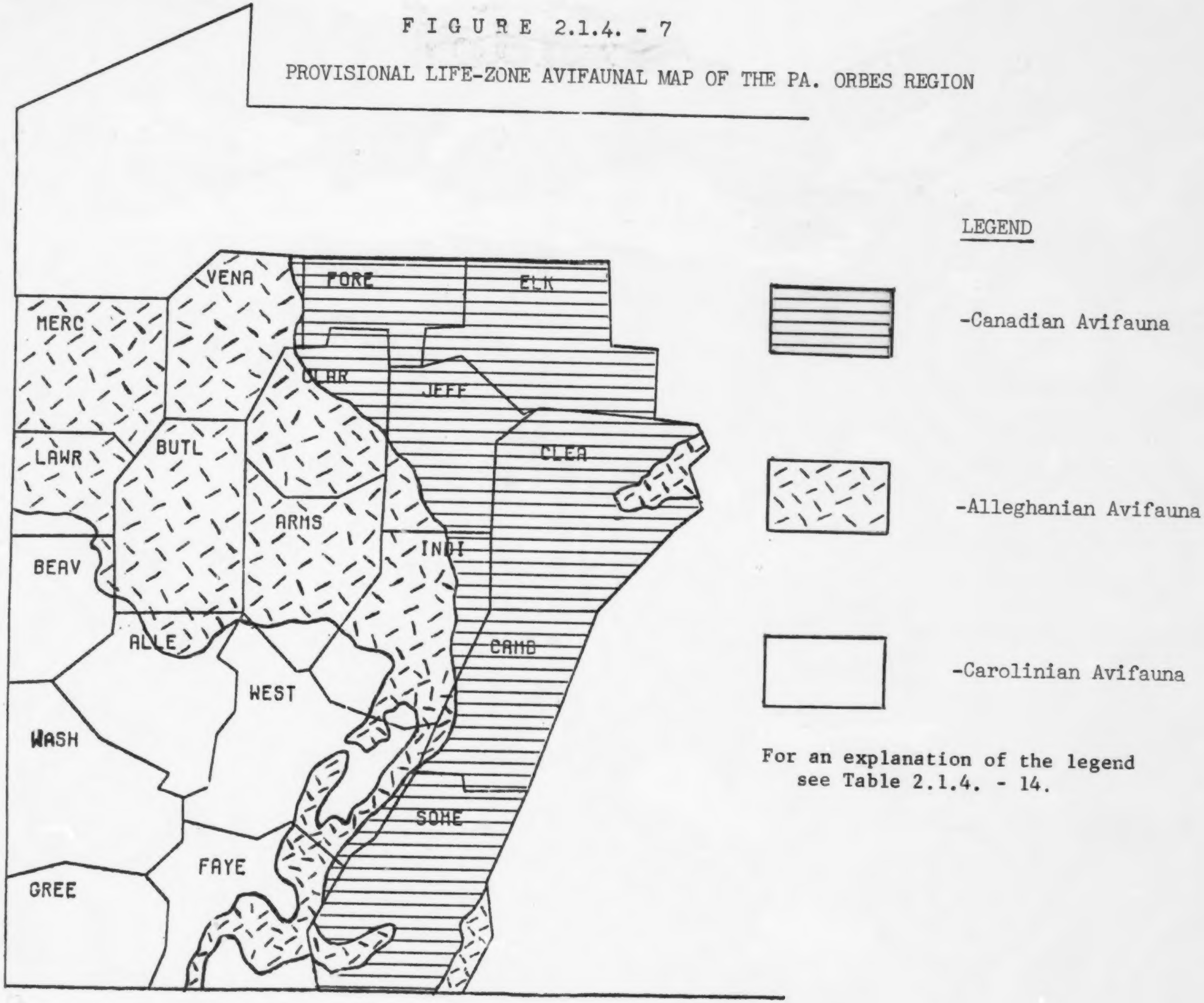
The Alleganian avifauna does not constitute a distinct zoogeographic unit in western Pennsylvania, since it lacks a unique assemblage of species. In the Pennsylvania ORBES region it may be regarded as a transition belt of varying width, an area of overlap where northern and southern avifaunal elements abut and intermingle (62).

The life-zone concept has been justifiably attacked by many ecologists over the years. Indeed, the zoogeography of many species cannot be adequately explained by this method. The concept has been presented herein merely to illustrate the current distributional trend of a receeding northern avifauna and an expanding southern avifauna. Todd (62) notes that although this trend is probably "characteristic of life flowing north in the backwash of the last glaciation," it has undoubtedly been accelerated and modified by man.

The draft material of the Army Corps of Engineers' "Environmental Resource Inventory" (48) indicates that 284 species of birds occur in western Pennsylvania (35). However, only 186 of these birds can be legitimately categorized as "relatively abundant."

F I G U R E 2.1.4. - 7

PROVISIONAL LIFE-ZONE AVIFAUNAL MAP OF THE PA. ORBES REGION


MERC
VENA
FORE
ELK
CLAR
JEFF
LAWR
BUTL
CLEA
ARMS
INDI
BEAV
ALLE
CAMB
WEST
WASH
SOME
FAYE
GREE
LEGEND
-Canadian Avifauna
-Alleghanian Avifauna
-Carolinian Avifauna

For an explanation of the legend see Table 2.1.4. - 14.

SOURCE: Adapted from Todd (62)

TABLE 2.1.4. -14
KEY TO LEGEND OF PROVISIONAL LIFE-ZONE AVIFAUNA MAP (Figure 2.1.4.-7)

Canadian Avifauna	Alleghanian Avifauna	Carolinian Avifauna
Eastern Goshawk	Yellow-bellied Sapsucker	Turkey Vulture
Yellow-bellied Flycatcher	Least Flycatcher	Barn Owl
Alder Flycather	Tree Swallow	Red-bellied Woodpecker
Olive-sided Flycatcher	Black-capped Chickadee	Acadian Flycatcher
Red-breasted Nuthatch	Veery	Carolina Chickadee
Brown Creeper	Nashville Warbler	Tufted Titmouse
Eastern Winter Wren	Black-throated Green Warbler	Bewick's Wren
Eastern Hermit Thrush	Chestnut-sided Warbler	Carolina Wren
Swainson's Thrush	Bobolink	Eastern Mockingbird
Eastern Golden-crowned Kinglet	Rose-breasted Crosbeak	Blue-gray Gnatcatcher
Solitary Vireo	Eastern Purple Finch	Prothonotary Warbler
Magnolia Warbler	Eastern Savannah Sparrow	Worm-Eating Warbler
Black-throated Blue Warbler	Swamp Sparrow	Cerulean Warbler
Blackburnian Warbler		Kentucky Warbler
Northern Water Thrush and Grinnell's Water-Thrush		Louisiana Water-Thrush
Mourning Warbler		Yellow-breasted Chat
Canada Warbler		Hooded Warbler
Northern Pine Siskin		Eastern Cardinal
Red Crossbill		Bachman's Sparrow
Slate-colored Junco		
White-Throated Sparrow		

SOURCE: Todd (62)

Furthermore, the relative abundance of many species is a seasonal phenomenon due to annual migrations. The current status of five groups in the study area is as follows:

1. Waterfowl

The Pennsylvania ORBES region is located on a major waterfowl migration route which is part of the Atlantic flyway. Consequently, the rivers of the area occasionally serve as resting places for migrating species such as the ring-necked duck (*Aythya collaris*), greater scaup (*A. marila*), goldeneye (*Bucephala clangula*), bufflehead (*B. albeola*), mallard (*Anas p. platyrhynchos*), oldsquaw (*Clangula hyemalis*), and common merganser (*Mergus merganser*) (33, 34). Ducks which may remain in the area to breed include the mallard, wood duck (*Aix sponsa*), and black duck (*Anas rubripes*). Marsh and wading birds known to inhabit the area include the great blue heron (*Ardea herodias*), killdeer (*Charadrius vociferus*), belted kingfisher (*Megaceryle alcyon*), greater yellowlegs (*Tringa melanoleuca*), and lesser yellowlegs (*T. flavipes*).

The most significant wetlands for the production of waterfowl in western Pennsylvania are located in Crawford and Erie Counties to the north of the Pennsylvania ORBES region. Sites of particular importance within the Pennsylvania ORBES region include the Shenango Wildlife Management Area, State Game Lands #270, and the Great Blue Heron Rookery in Mercer County; Beaver Run Reservoir in Westmoreland County; and State Game Lands #95 in Butler County (32, 65, 66).

2. Songbirds

Songbirds comprise the largest group of terrestrial vertebrates in the Pennsylvania ORBES region. Strictly woodland species have generally experienced population decreases over the years due to the clearing of the virgin forests (62). Conversely, populations of species preferring second growth woodland and thickets, suburban backyards and gardens, and agricultural areas have tended to increase. Species such as the robin (*Turdus migratorius*), house wren (*Troglodytes aedon*), cardinal (*Cardinalis cardinalis*), starling* (*Sturnus vulgaris*), and house sparrow* (*Passer domesticus*) are currently thriving in such areas (33, 34, 67).

Past impacts on Pennsylvania's songbirds are attributable to numerous factors including:

a.) Habitat destruction (primarily deforestation).

b.) Intensified competition from introduced European species.

*These species were introduced from Europe.

c.) Predation by the house cat, crow, and red squirrel.

d.) Increases in populations of the cowbird.

e.) Illegal shootings.

f.) Miscellaneous deaths indirectly caused by man (i.e. pesticides, electrical transmission lines, large plate glass windows).

3. Gamebirds

Ring-necked pheasant (Phasianus colchicus), ruffed grouse (Bonasa u. umbellus), wild turkey (Meleagris gallopavo silvestris), and mourning dove (Zenaida macroura carolinensis) are the most sought after gamebirds in the Pennsylvania ORBES region; woodcock (Philohela minor), bobwhite quail (Colinus c. virginianus), and snipe (Capella gallinago) are also pursued by hunters, although not as intensely. Riparian bottomlands in the study area function as habitat for pheasant and doves. The wild turkey has suffered from encroaching civilization; consequently, these upland birds attain their maximum population densities in the sparsely settled, "big woods" counties such as Elk, Forest, Venango, and Clarion. Ruffed grouse prefer dense cover as their habitat; this species has benefited from small timber operations in Somerset, Fayette, Venango, and Clarion Counties (68, 69). Population data for the three most extensively studied gamebird species are presented in Tables 2.1.4. - 15, 16, and 17.

4. Predatory Birds

Approximately twenty-one species of predatory birds are known from western Pennsylvania (33, 34). Hawks and owls account for the greatest number of species, although eagles, falcons, and osprey are also known from the area. Most of the predatory birds inhabit woodlands, however many species frequently venture into fields while hunting. Red-tailed hawk (Buteo jamaicensis), Cooper's hawk (Accipiter cooperi), great horned owl (Bubo v. virginianus), and screech owl (Otus asio) are some of the common predatory birds of the Pennsylvania ORBES region (33, 34, 60).

Although predatory birds have suffered from habitat destruction, significant impacts have also resulted from other miscellaneous factors. Adverse effects from the bioaccumulation of pesticides have received national attention. Predatory birds, including the bald eagle (61), have been known to die from electrocution on transmission lines. Substantial impacts in the Pennsylvania ORBES region have resulted from formerly existing predator control programs. The campaign instituted against the goshawk (a predator of game animals and domestic fowl) in 1929 best exemplifies such impacts. During the first year of this statewide

TABLE 2.1.4.-15

RING-NECKED PHEASANT POPULATION
DATA* FOR PENNSYLVANIA ORBES COUNTIES

County	Range Type	Thousands Acres Habitat[1]	Avg. Annual Peak Population Density[2]	Avg. Fall Population Density[3]	Avg. Annual Harvest[4]	Harvest Value[5]
ALLE	1st Class	13.1	533	355	142	3.02
	2nd Class	331.5	272	181	54	1.15
	3rd Class	28.2	177	118	29	0.62
ARMS	1st Class	2.6	302	201	80	1.70
	2nd Class	9.8	143	96	29	0.62
	3rd Class	339.8	116	77	9	0.40
BEAV	2nd Class	190.5	197	131	39	0.83
	3rd Class	15.7	151	100	25	0.53
BUTL	2nd Class	359.9	254	169	51	1.09
	3rd Class	103.3	186	125	31	0.66
CAMB	2nd Class	39.3	314	209	63	1.34
	3rd Class	98.3	236	157	39	0.83
CLAR	2nd Class	38.9	399	266	80	1.70
	3rd Class	78.9	215**	144**	50**	1.06**
CLEA	2nd Class	10.5	115	77	23	0.49
	3rd Class	155.3	84	56	14	0.30
ELK	3rd Class	68.3	75**	50**	18**	0.38**
FAYE	1st Class	64.2	646	431	172	3.66
	2nd Class	87.8	327	218	65	1.38
	3rd Class	107.0	251	167	42	0.89
FORE	3rd Class	13.3	Insufficient Data for Population Calculations			
GREE	2nd Class	61.6	148	99	30	0.64
	3rd Class	286.0	109	73	18	0.38
INDI	2nd Class	9.8	224	149	45	0.95
	3rd Class	313.8	160	106	27	0.57
JEFF	3rd Class	121.6	191	128	32	0.68
LAWR	2nd Class	215.4	352	235	71	1.51
	3rd Class	19.4	247	165	41	0.87
MERC	2nd Class	136.6	195**	130**	46**	0.98**
	3rd Class	256.5	122**	81**	28**	0.60**
SOME	2nd Class	20.3	289	192	58	1.23
	3rd Class	209.7	206	137	34	0.72
VENA	2nd Class	18.9	137**	92**	32**	0.68**
	3rd Class	182.1	88**	58**	20**	0.43**
WASH	2nd Class	239.8	395	264	79	1.68
	3rd Class	254.9	298	199	50	1.06
WEST	1st Class	248.4	586	391	156	3.32
	2nd Class	281.8	307	205	62	1.32
	3rd Class	3.2	210	140	35	0.75

* 1972 - '73 averages; cocks only unless otherwise noted.

** Cocks and hens.

1. Thousands of acres
2. Pheasants/thousand acres
3. Pheasants/thousand acres (immediately prior to commencement of the hunting season).
4. Pheasants harvested/thousand acres (during the hunting season).
5. Dollars/acre (based soley on hunters' expenditures in 1975).

SOURCE: Palmer (70).

TABLE 2.1.4.-16

RUFFED GROUSE POPULATION
DATA* FOR PENNSYLVANIA
ORBES COUNTIES

County	Amount of Habitat[1]	Avg. Annual Peak Pop. Density[2]	Avg. Fall Population Density[3]	Avg. Annual Harvest[4]	Harvest Value[5]
ALLE	86.2	253	169	25	0.23
ARMS	218.9	564	376	56	0.51
BEAV	134.6	421	281	42	0.39
BUTL	261.6	399	266	40	0.37
CAMB	284.6	280	187	28	0.26
CLAR	272.6	233	155	23	0.21
CLEA	608.0	185	123	18	0.17
ELK	360.4	107	72	11	0.10
FAYE	317.3	121	80	12	0.11
FORE	138.1	171	114	17	0.16
GREE	147.8	534	356	53	0.49
INDI	289.4	434	289	26	0.24
JEFF	292.8	288	192	29	0.27
LAWR	92.7	185	124	19	0.17
MERC	147.6	356	237	36	0.33
SOME	443.4	264	176	26	0.24
VENA	352.7	240	160	24	0.22
WASH	192.7	335	223	33	0.30
WEST	312.1	279	186	28	0.26

* 1972-73 averages
1. Thousands of acres
2. Grouse/thousand acres
3. Grouse/thousand acres (immediately prior to commencement of the hunting season).
4. Grouse harvested/thousand acres (during the hunting season).
5. Dollars/acre (based soley on hunters' expenditures in 1975).

SOURCE: Palmer (70)

TABLE 2.1.4.-17

WILD TURKEY POPULATION DATA*
FOR SOME PENNSYLVANIA ORBES COUNTIES**

County	Amount of Habitat[1]	Avg. Annual Peak Pop. Density[2]	Avg. Fall Population Density[3]	Avg. Annual Harvest[4]	Harvest Value[5]
CAMB	102.4	34.5	24.6	4.9	0.49
CLAR	144.0	9.9	7.0	1.4	0.14
CLEA	601.6	15.0	10.7	2.1	0.21
ELK	505.6	22.2	15.9	3.2	0.32
FORE	262.4	24.2	17.3	3.5	0.35
JEFF	233.6	28.5	20.4	4.1	0.41
SOME	160.0	32.2	23.0	4.6	0.46
VENA	192.0	18.4	13.1	2.6	0.26

* 1972-73 averages
** Remaining Pa. ORBES Counties have insufficient data for population calculations.
1) Thousands of acres
2) Turkeys/thousand acres
3) Turkeys/thousand acres (immediately prior to commencement of the hunting season).
4) Turkeys harvested/thousand acres (during the hunting season).
5) Dollars/acre (based soley on hunters' expenditures in 1975).

SOURCE: Palmer (70)

program, seventy-five percent of the birds presented as goshawk for bounty were other species of predators including: sparrow hawk, screech owl, golden eagle, turkey vulture, red-tailed hawk, red-shouldered hawk, Cooper's hawk, osprey, and even peregrine falcon (71, 72). More importantly, the predator control programs of the past convinced a significant number of Pennsylvania nimrods that predatory birds threaten game populations. Consequently, many predatory birds are still "shot on sight" in violation of both state and federal laws.

5. Endangered Birds

The peregrine falcon (*Falco peregrinus*), Kirtland's warbler (*Dendroica kirtlandii*), and southern bald eagle (*Haliaeetus l. leucocephalus*) are endangered birds which may occur in the Pennsylvania ORBES region. The falcon and warbler are occasional migrants through the area; the eagle nests in Crawford County which borders the ORBES region.

The peregrine falcon prefers rough, wooded country as its habitat. Todd (62) notes that peregrines have a tendency to avoid flat cultivated areas. In Pennsylvania the breeding areas of this falcon were typically located on cliffs in the vicinity of water. Although this falcon has not been known to breed in Pennsylvania since 1952 (56), thirty-four rock ledges once served as nesting sites in the state (72).

The abundance of peregrines in pre-colonial times has been estimated at a mere five thousand birds for the entire continent (73). The species was therefore prone to impact from man and his activities since the time of European colonization. The exact reasons for the demise of the peregrine are not definitely known; however, pesticides are suspected of killing birds directly and rendering eggs infertile (61, 73).

The Kirtland's warbler is a small songbird that nests in the jack-pine forests of Michigan and winters in the Bahama Islands. While migrating in the spring and fall, this bird has been known to pass through the Pennsylvania ORBES region (33, 34, 62). Mayfield (74) has ascribed their demise to the northward recession of the jack-pine plant association and increased pressure from the brown-headed cowbird.

The southern bald eagle currently inhabits a few areas in Crawford County, Pennsylvania. Three nests located in the Black Jack and Sanctuary areas of Pymatuning State Park and in Conneaut Marsh near Geneva usually yield two eggs/nest/year; however, only one of these six eggs typically hatches (75). Pesticides are suspected of being a possible cause of this poor reproductive success.

At a recent symposium on the status of nongame species in Pennsylvania the following recommendations were made for the management of the Commonwealth's avifauna:

a.) Adoption of guidelines (76) concerning the minimum breeding area requirements of warblers and vireos. Such guidelines should be incorporated into strategems for the management of state parks and forests.

b.) Elimination of pesticide use in the control of the gypsy moth.

c.) Consolidation and extension of existing knowledge of Pennsylvania birdlife.

C. Mammals

Prior to European colonization, the vast forests of Pennsylvania supported a diverse mammalian fauna. Wolf (*Canis lupus*), cougar (*Felis concolor*), beaver (*Castor canadensis*), fisher (*Martes pennati*), marten (*M. americana*), Canadian lynx (*Lynx canadensis*), elk (*Cervus canadensis*), and even an occasional wolverine (*Gulo luscus*) were known to inhabit pre-settlement Pennsylvania (14, 77, 78). Some authors contend that moose (*Alces alces*) and bison (*Bison bison*) were also present, but such claims have never been substantiated (79, 80, 81). By the end of the nineteenth century, all of the aforementioned species had become extinct from the state (77). Moreover, market hunting had made white-tailed deer (*Odocoileus virginiana*) so rare, that occasional sitings merited front page coverage in certain area newspapers (81). Later efforts by the Pennsylvania Game Commission resulted in the re-introduction of the beaver and elk. Management techniques likewise helped to greatly increase the deer herd. Nonetheless, the majority of the original boreal species have remained extinct from the state.

The draft material of the Corps of Engineers', "Environmental Resource Inventory," (48) lists sixty-two species of mammals as currently occurring in western Pennsylvania. About half of these species can be legitimately categorized as common. During the last century, populations of the white-tailed deer (*Odocoileus virginianus*), eastern cottontail rabbit (*Sylvilagus floridanus*), eastern chipmunk (*Tamias striatus*), gray squirrel (*Sciurus carolinensis*), woodchuck (*Marmota monax*), red fox (*Vulpes vulpes*), meadow vole (*Microtus pennsylvanicus*), and raccoon (*Procyon lotor*) have faired well and in many instances have shown evidence of increasing. Conversely, bobcat (*Lynx rufus*) and river otter (*Lontra canadensis*) populations have suffered extensive damage in the Pennsylvania ORBES region.

Current patterns of mammalian distribution within the study area vary from species to species. Many mammals such as the chipmunk, gray squirrel, and raccoon are abundant throughout the Pennsylvania ORBES region. Nonetheless, several general trends are evident:

a.) Deer and black bear (*Ursus americanus*) population densities are greatest in the northeastern counties of the study area.

b.) Porcupine (*Erethizon dorsatum*) and beaver populations are essentially confined to the northern counties.

c.) Fox squirrel (*Sciurus niger rufiventer*) populations are essentially confined to the counties around Pittsburgh.

d.) Cottontail rabbit, woodchuck, and vole, population densities are greatest in the semi-agricultural counties around Allegheny County.

e.) The Norway rat (*Rattus norvegicus*), an introduced pest, reaches peak densities on riparian land around urban areas.

The Pennsylvania Game Commission classifies deer, elk*, black bear, wild rabbits, woodchuck, raccoon, squirrels, bobcat*, and snowshoe hare as game mammals. Population data on the three most extensively studied species is presented in Tables 2.1.4.-18, 19, and 20. Mink, muskrat, foxes, river otter*, beaver, skunk, and opossum are classified as furbearers. Hunting and trapping constitute big business in the Commonwealth of Pennsylvania; license sales alone typically exceed 14 million dollars annually. Millions more are spent each year on ammunition, firearms, and supplies. In the 1976-77 marketing year, the statewide fur harvest (673,747 pelts, comprised chiefly of muskrat) was worth 6.12 million dollars.

Past impacts on Pennsylvania's mammalian fauna are partially attributable to deforestation via excessive logging, market hunting, intensive fur trapping, and predator control programs. These activities no longer represent ecological threats to the Pennsylvania ORBES region; they have long since been either discontinued or placed under strict regulations. Urbanization and industrialization are currently the greatest source of detrimental impacts on wildlife. Increased noise levels, habitat destruction from construction activities, predation by free-roaming pets, gross pollution, and highway traffic accidents are among the more obvious causative agents.

Indeed, millions of mammals are killed every year on Pennsylvania's roads. Rabbit, raccoon, woodchuck, opossum, skunk, and deer are the most susceptible species. Quantifications of current annual small game road kills are not available; however, it is widely believed that such mortalities exceed the annual hunting harvest by a considerable amount. Big game road kills are less than hunting mortalities; however, they do account for a significant fraction of the total annual attrition in deer. Those road-killed deer which are located by Game Commission personnel are recorded. Doubtlessly, many crippled individuals amble off the highway and die without being reported or located. Thusly, the

*Hunting or trapping of these species is currently prohibited.

TABLE 2.1.4.-18

GRAY SQUIRREL POPULATION DATA FOR PENNSYLVANIA ORBES COUNTIES

County	Amount of Habitat[1]	Avg. Annual Peak Population Density[2]	Avg. Fall Population Density[3]	Avg. Annual Harvest[4]	Harvest Value[5]
ALLE	86.2	4.4	2.9	0.29	2.13
ARMS	218.9	1.8	1.2	0.12	0.88
BEAV	134.6	2.2	1.5	0.15	1.09
BUTL	261.6	2.2	1.4	0.14	1.05
CAMB	284.6	1.4	0.9	0.09	0.68
CLAR	272.6	1.4	0.9	0.09	0.63
CLEA	608.0	1.0	0.7	0.07	0.48
ELK	360.4	0.5	0.3	0.03	0.23
FAYE	317.3	1.2	0.8	0.08	0.60
FORE	138.1	2.3	1.5	0.15	1.09
GREE	147.8	3.3	2.2	0.22	1.60
INDI	289.4	2.1	1.4	0.14	1.01
JEFF	292.8	1.7	1.2	0.12	0.84
LAWR	92.7	2.0	1.3	0.13	0.97
MERC	147.6	2.3	1.5	0.15	1.12
SOME	443.4	1.6	1.1	0.11	0.79
VENA	352.7	1.1	0.7	0.08	0.54
WASH	192.7	2.9	1.9	0.20	1.42
WEST	312.1	2.6	1.7	0.17	1.26

1. Thousands of acres
2. Squirrels/acre
3. Squirrels/acre (immediately prior to commencement of the hunting season).
4. Squirrels harvested/acre (during the hunting season).
5. Dollars/acre (based solely on hunters' expenditures).

SOURCE: Palmer (70).

TABLE 2.1.4.-19

COTTONTAIL RABBIT POPULATION DATA FOR PENNSYLVANIA ORBES COUNTIES

County	Amount of Habitat[1]	Avg. Annual Peak Population Density[2]	Avg. Fall Population Density[3]	Avg. Annual Harvest[4]	Harvest Value [5]
ALLE	194.8	6.8	1.6	0.47	11.52
ARMS	277.2	5.8	1.3	0.20	4.91
BEAV	169.1	6.8	1.5	0.31	7.62
BUTL	333.2	6.7	1.5	0.30	7.48
CAMB	226.6	4.9	1.1	0.23	5.55
CLAR	164.7	6.1	1.4	0.28	6.81
CLEA	184.1	6.8	1.5	0.31	7.62
ELK	135.0	4.0	0.9	0.14	3.33
FAYE	266.9	5.1	1.1	0.23	5.67
FORE	76.0	1.6	0.4	0.06	1.36
GREE	289.2	4.5	1.0	0.10	2.52
INDI	323.1	5.6	1.3	0.19	4.69
JEFF	184.0	6.8	1.5	0.31	7.62
LAWR	177.5	5.4	1.2	0.24	5.99
MERC	330.1	5.2	1.2	0.18	4.42
SOME	371.4	5.3	1.2	0.18	4.44
VENA	122.9	5.5	1.3	0.31	7.75
WASH	428.8	5.4	1.2	0.25	6.07
WEST	426.8	6.0	1.4	0.34	8.36

1. Thousands of acres.
2. Rabbits/acre.
3. Rabbits/acre (immediately prior to commencement of the hunting season).
4. Rabbits harvested/acre (during the hunting season).
5. Dollars/acre (based solely on hunters' expenditures in 1975).

SOURCE: Palmer (70).

TABLE 2.1.4.-20

WHITE-TAILED DEER POPULATION DATA* FOR PENNSYLVANIA ORBES COUNTIES

County	Amount of Habitat[1]	Avg. Annual Peak Population Density[2]	Avg. Fall Population Density[3]	Avg. Annual Harvest[4]	Harvest Value[5]
ALLE	210.3	14.7	11.8	1.8	1.75
ARMS	391.0	30.5	24.4	4.9	4.85
BEAV	232.4	7.8	6.2	1.9	1.86
BUTL	466.6	19.2	15.4	3.8	3.83
CAMB	408.7	23.8	19.0	4.8	4.74
CLAR	358.2	46.4	37.1	7.4	7.37
CLEA	688.7	39.3	31.4	6.3	6.25
ELK	387.3	103.3	82.6	8.3	8.22
FAYE	463.7	8.7	7.0	1.7	1.74
FORE	147.8	193.4	154.7	23.2	23.10
GREE	348.3	27.9	22.3	3.4	3.34
INDI	482.2	30.5	24.4	6.1	6.07
JEFF	389.0	46.0	36.8	7.4	7.32
LAWR	213.6	7.8	6.2	0.9	0.93
MERC	380.3	10.0	8.0	2.0	1.98
SOME	655.1	15.0	12.0	4.2	4.18
VENA	412.1	56.1	44.9	8.8	8.93
WASH	496.2	9.1	7.3	1.8	1.81
WEST	576.6	20.3	16.3	4.1	4.04

*Based on 1972-75 averages

1. Thousands of acres.
2. Deer/thousand acres.
3. Deer/thousand acres (immediately prior to commencement of the hunting season).
4. Deer harvested/thousand acres (during the hunting season).
5. Dollars/acre (based solely on hunters' expenditures in 1975).

SOURCE: Palmer (70).

data presented in Table 2.1.4.-21 represents a conservative estimate of annual white-tailed mortalities due to traffic mishaps. Westmoreland, Butler and Venango Counties have among the highest mortalities in the Commonwealth. Fergus (83) notes that many deer and bear are killed along the portion of Interstate 80 that cuts through the heavily wooded Allegheny Plateau region (Clearfield, Jefferson, Clarion, and Venango Counties).

Approximately ten species of mammals are considered to be rare in the Pennsylvania ORBES region. By virtue of their present status, the following four species merit additional consideration.

1. River Otter (Lontra canadensis)

Prior to the twentieth century, this aquatic mustelid was a relatively common inhabitant of many Pennsylvania waterways. At the present time this species is very rare in the state and is probably extinct from the study area. The last individuals known to occur in the Pennsylvania ORBES region are as follows: the Ohio River in 1898, the Allegheny and Monongahela Rivers in 1899, Jacob's Creek in 1905, and Dunkard Creek in 1947 (79, 84). Otters were occasionally reported along wild sections of the Clarion River in the late 1940's, but Richmond and Rosland (85) were unable to verify any of these sitings.

The extirpation of otters from western Pennsylvania has been ascribed to excessive deforestation, water pollution, and intensive trapping (86). The current statewide population has been estimated to be between a range of 285-465 animals, ninety percent of which are confined to the northeastern counties of Pike, Monroe, and Wayne (87). Wildlife biologists with the Game Commission describe the otter as "barely holding its own" despite complete protection in 1952 (88). Nonetheless, Eveland and Ryman note that half of Pennsylvania's sixty-six counties contain suitable otter habitat. Moreover, a limited live-trapping and transferral program is now underway in an effort to repopulate the Commonwealth. The preservation of relatively large, clean streams with wild riparian land is necessary if this program is to be successful.

2. Elk (Cervus canadensis)

In pre-colonial and colonial times the Pennsylvania elk herds are believed to have attained their peak densities in the mountainous central portion of the state and in the Pocono region of the northeast; however, elk did indeed occur throughout much of the Pennsylvania ORBES region (79). The native Pennsylvania elk became extinct between 1860 and 1870. Stocking efforts commenced in 1913 with individuals procured from Yellowstone National Park; these animals were

TABLE 2.1.4.-21

AVERAGE ANNUAL[1] REPORTED WHITE-TAILED DEER MORTALITIES DUE TO TRAFFIC MISHAPS IN THE PENNSYLVANIA ORBES REGION

County	Range	Mean	One Standard Deviation
ALLE	280 - 493	367	± 75
ARMS	267 - 666	505	± 132
BEAV	186 - 342	275	± 56
BUTL	637 - 1,133	807	± 176
CAMB	267 - 345	312	± 26
CLAR	504 - 745	593	± 86
CLEA	614 - 970	832	± 129
ELK	198 - 391	303	± 79
FAYE	118 - 300	206	± 59
FORE	401 - 592	469	± 85
GREE	173 - 392	259	± 74
INDI	502 - 695	596	± 81
JEFF	497 - 831	690	± 144
LAWR	80 - 119	102	± 16
MERC	304 - 417	342	± 40
SOME	325 - 456	392	± 49
VENA	652 - 1,041	845	± 140
WASH	209 - 493	312	± 89
WEST	907 - 1,260	1,089	± 136
TOT*	7,456 -10,167	9,307	± 936
STTO**	23,845 -29,914	26,177	±2,007

1. 1971-1977 data

* Total for the Pennsylvania ORBES region

** Total for the entire Commonwealth of Pennsylvania

SOURCE: Adapted from Pa. Game Commission (82).

released chiefly in the counties of central Pennsylvania. In the 1920's it became obvious that the elk population could not withstand hunting pressure, so the species was given complete protection in 1931.

Elk are currently very rare in Pennsylvania. The herd size has typically averaged about fifty or sixty individuals during the past decade (89). These animals are essentially confined to the Cameron-Elk-Forest County area. The majority of the population occurs between St. Mary's and Benezette in Elk County and on State Game Lands No. 14 in Cameron County (90, 91, 92). Preferred elk habitat consists of grassy openings and fringe areas where early post-disturbance successional communities merge with mature forest, providing both food and cover. The gradually maturing forests of State Game Lands No. 14 has eliminated many of these savanna-like areas, thereby pushing the elk to nearby agricultrual areas (93). The Game Commission has, therefore, undertaken a program of selected land clearing on SGL No. 14 in order to encourage the elk to remain on this tract.

The current estimated annual mortality rate for the herd is about fifteen percent. The deaths are due to brain worm infestation, natural attrition, shootings by careless deer hunters, shootings by farmers due to crop damage, and an occasional road kill (89). Moreover, it is believed that elk are "high strung" animals and that a lack of solitude may result in lower reproductive rates (79). This fact is especially alarming when one considers that elk aren't exceptionally prolific animals even under natural conditions.

3. Bobcat (Lynx rufus)

This nocturnal carnivore was relatively common throughout most of the state prior to the early 1930's. Because this cat preys upon game animals and livestock, the Commonwealth paid bounties on it from 1810 until the mid-1900's. During the twentieth century claims averaged about 200-300 cats per year with a range of 97-862 per year (79, 94). This predator control program is believed to have had a significant impact on the state's population (71, 95).

The present statewide population of bobcats is estimated from one hundred to six hundred individuals (96). The Game Commission believes that the population is currently on the upswing and although it is still very rare, it is not likely to become extinct (97). Prime bobcat habitat consists of extensive tracts of second growth woodland with brushy areas. In Pennsylvania they avoid areas with extensive farmland (92). Rocky recesses are typically chosen as den areas, therefore ledges, caves, and boulder piles may be considered valuable habitat assets. The bobcat is susceptible to impact from man due to its wide-ranging nature; it is known that males may travel up to twenty miles in a single night in search of a mate. If any individuals currently occur within the Pennsylvania ORBES region, they are doubtlessly confined to sparsely populated areas in the northern and eastern counties (e.g. Elk, Forest, Clearfield, Cambria, and Somerset).

4. Indiana Bat (Myotis sodalis)

This is the only Pennsylvania mammal that is currently on the federal "Endangered Species List." Very little knowledge exists as to the bionomy and habits of this bat, for it was not described as a species until 1928 at which time it was already rare. In the Pennsylvania ORBES region, small wintering colonies have been reported from caves in Fayette and Westmoreland Counties. Future encounters with man could be severely detrimental to this species since hibernating cave populations are concentrated and, therefore, vulnerable to impact. (79).

At a recent symposium on the status of nongame species in Pennsylvania (60), the mammalogical committee made the following recommendations for the preservation of the Commonwealth's mammalian fauna:

a.) Undertake a state mammal field survey.

b.) Construct a detailed vegetation habitat map of the state.

c.) Make detailed studies of the transformations induced by major developments (highways, strip mines, etc.)

d.) Develop guidelines for minimizing destructive changes.

e.) Identify vulnerable species and habitats.

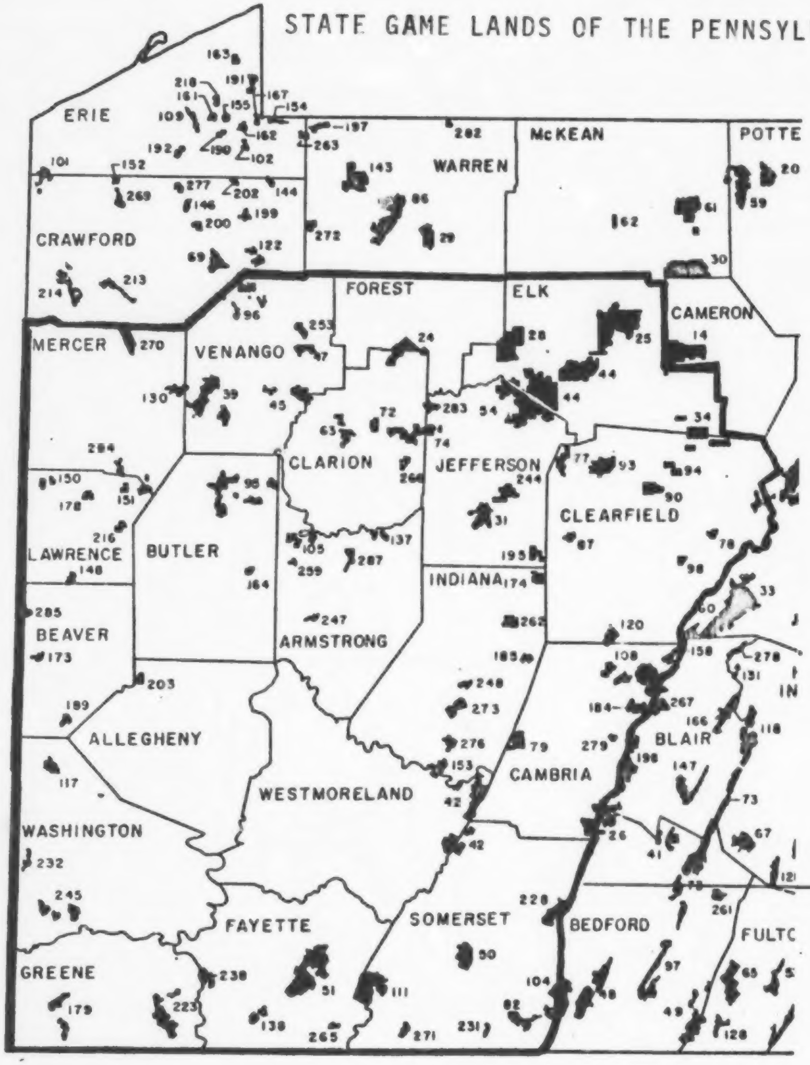
f.) Purchase remaining outstanding natural areas.

2.1.4.-3 SPECIFIC HABITATS

The Pennsylvania ORBES region contains a substantial number of wild, scenic, natural and/or recreational areas. The Allegheny National Forest comprises the largest single tract; the portion within the study area occupies over 224 thousand acres of Forest and Elk Counties. Throughout the study area, seventy-seven State Game Lands account for approximately 277 thousand acres (see Fig. 2.1.4.-8). Twenty-two existing State Parks and five State Parks currently under design, development, or acquisition contribute 119 thousand additional acres to the study area (see Fig. 2.1.4.-9)

FIGURE 2.1.4. - 8

STATE GAME LANDS OF THE PENNSYLVANIA ORBES REGION


ERIE
CRAWFORD
WARREN
McKEAN
POTTE
MERCER
VENANGO
FOREST
ELK
CAMERON
CLARION
JEFFERSON
CLEARFIELD
LAWRENCE
BUTLER
BEAVER
ARMSTRONG
INDIANA
ALLEGHENY
WESTMORELAND
CAMBRIA
BLAIR
WASHINGTON
FAYETTE
SOMERSET
BEDFORD
FULTC
GREENE
Boundary of the Pa. ORBES Region

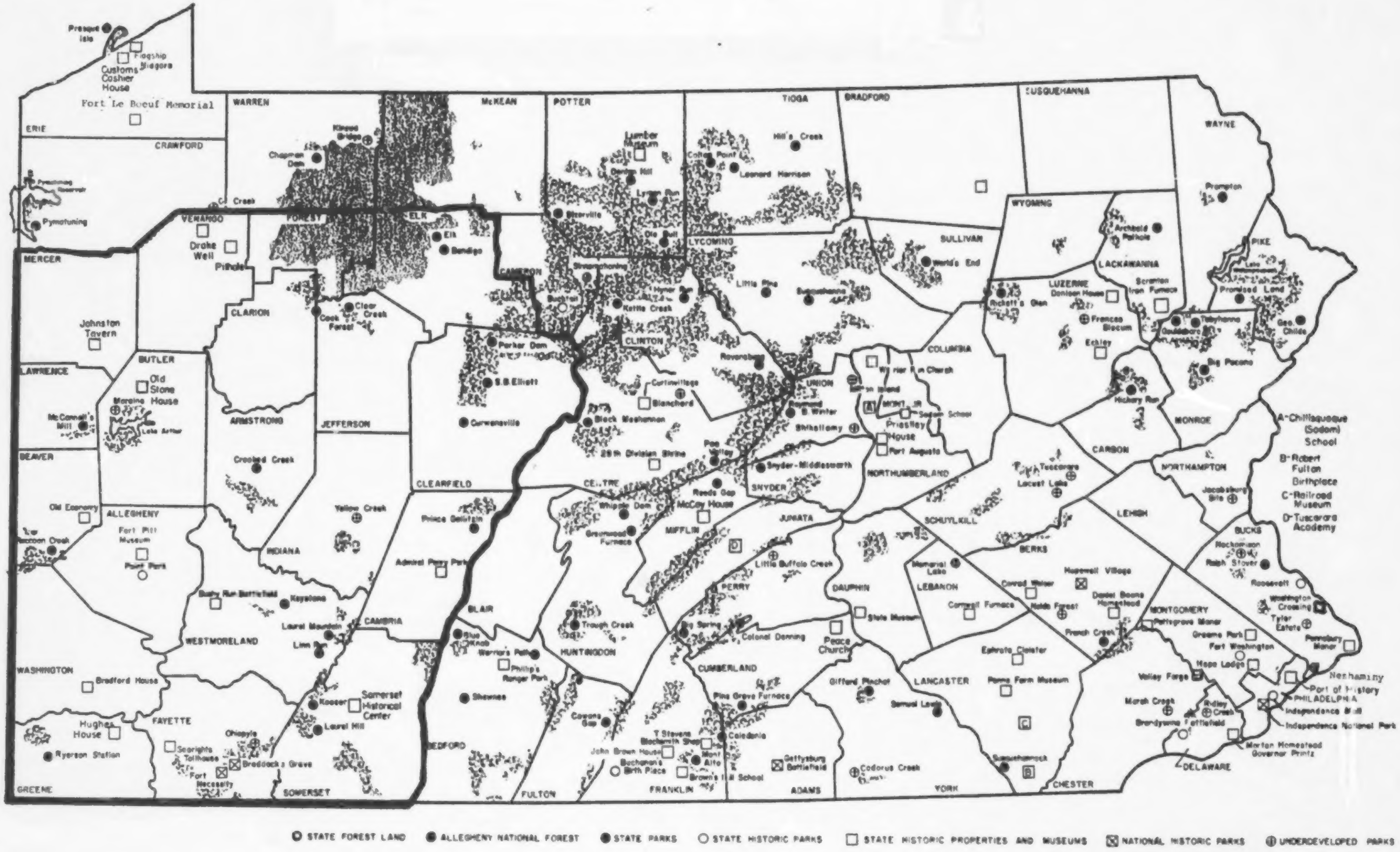
Approx. Area of State Game Lands in the Study Region (thousands of acres)

ALLE	1.2
ARMS	4.8
BEAV	2.7
BUTL	8.6
CAMB	17.3
CLAR	11.0
CLEA	24.7
ELK	59.6
FAYE	19.7
FORE	7.8
GREE	9.2
INDI	8.1
JEFF	41.0
LAWR	2.1
MERC	4.4
SOME	17.2
VENA	21.0
WASH	7.4
WEST	9.5
TOT	277.3

SOURCE: Adapted from Pa. Game Commission (98).

FIGURE 2.1.4. - 9

STATE AND NATIONAL FORESTS/PARKS OF THE PENNSYLVANIA ORBES REGION


ERIE
CRAWFORD
WARREN
McKEAN
POTTER
TIOGA
BRADFORD
SUSQUEHANNA
WAYNE
PIKE
WYOMING
LACKAWANNA
LUZERNE
SULLIVAN
LYCOMING
CLINTON
CAMERON
ELK
FOREST
VENANGO
MERCER
LAWRENCE
BUTLER
CLARION
JEFFERSON
ARMSTRONG
BEAVER
ALLEGHENY
INDIANA
CLEARFIELD
CENTRE
UNION
COLUMBIA
MONTOUR
NORTHUMBERLAND
SNYDER
MIFFLIN
JUNIATA
PERRY
DAUPHIN
LEBANON
SCHUYLKILL
CARBON
MONROE
NORTHAMPTON
LEHIGH
BERKS
BUCKS
MONTGOMERY
CHESTER
DELAWARE
PHILADELPHIA
LANCASTER
YORK
ADAMS
CUMBERLAND
FRANKLIN
FULTON
BEDFORD
HUNTINGDON
BLAIR
CAMBRIA
SOMERSET
WESTMORELAND
FAYETTE
WASHINGTON
GREENE
Presque Isle
Flagship Niagara
Customs Cashier House
Fort Le Boeuf Memorial
Pymatuning Reservoir
Pymatuning
Kinzua Bridge
Chapman Dam
Drake Well
Pithole
Elk
Bendigo
Clear Creek
Cook Forest
Johnston Tavern
Old Stone House
Moraine
Lake Arthur
McConnell's Mill
Crooked Creek
Old Economy
Raccoon Creek
Fort Pitt Museum
Point Park
Yellow Creek
Prince Gallitzin
Admiral Peary Park
Bushy Run Battlefield
Keystone
Laurel Mountain
Linn Run
Bradford House
Kooser
Somerset Historical Center
Laurel Hill
Hughes House
Ryerson Station
Searights Tollhouse
Ohiopyle
Braddock's Grave
Fort Necessity
Lumber Museum
Denton Hill
Lyman Run
Ole Bull
Sizerville
Sinnemahoning
Bucktail
Kettle Creek
Hyner Run
Parker Dam
S.B. Elliott
Curwensville
Black Moshannon
Curtinvillage
Blanchard
28th Division Shrine
Whipple Dam
Greenwood Furnace
McCoy House
Reeds Gap
Poe Valley
Colton Point
Leonard Harrison
Hill's Creek
Little Pine
Susquehanna
Ravensburg
Raymond B. Winter
Shikellamy
Snyder-Middleswarth
World's End
Warrior Run Church
Priestley House
Fort Augusta
Sodom School
Ricketts Glen
Denison House
Frances Slocum
Eckley
Archbald Pothole
Scranton Iron Furnace
Prompton
Promised Land
Tobyhanna
Gouldsboro
Geo. Childs
Big Pocono
Hickory Run
Tuscarora
Locust Lake
Jacobsburg Site
Little Buffalo Creek
Trough Creek
Blue Knob
Warriors Path
Phillips Ranger Park
Shawnee
Cowans Gap
Big Spring
Colonel Denning
Peace Church
State Museum
Memorial Lake
Cornwall Furnace
Conrad Weiser
Hopewell Village
Daniel Boone Homestead
French Creek
Pine Grove Furnace
Caledonia
T Stevens Blacksmith Shop
John Brown House
Buchanan's Birth Place
Mont Alto
Brown's Hill School
Gettysburg Battlefield
Gifford Pinchot
Samuel Lewis
Codorus Creek
Ephrata Cloister
Penna Farm Museum
Susquehannock
Nockamixon
Ralph Stover
Roosevelt
Washington Crossing
Tyler Estate
Pennsbury Manor
Neshaminy
Pottsgrove Manor
Graeme Park
Fort Washington
Hope Lodge
Valley Forge
Marsh Creek
Ridley Creek
Brandywine Battlefield
Port of History
Independence Hall
Independence National Park
Morton Homestead
Governor Printz
A-Chillisquaque (Sodom) School
B-Robert Fulton Birthplace
C-Railroad Museum
D-Tuscarora Academy
STATE FOREST LAND
ALLEGHENY NATIONAL FOREST
STATE PARKS
STATE HISTORIC PARKS
STATE HISTORIC PROPERTIES AND MUSEUMS
NATIONAL HISTORIC PARKS
UNDERDEVELOPED PARKS

SOURCE: Adapted from the Pa. Dept. of Commerce (99).

Reproduced from
best available copy.

and Table 2.1.4.-22). Various picnic areas, historical sites and county parks account for several thousand more acres. For a more detailed mapping of these areas, the reader is referred to Plates IV-21 and IV-19 of Pennsylvania's, "Comprehensive Water Quality Management Plan." (COWAMP) for study areas 8 and 9 respectively (100, 101).

The Western Pennsylvania Conservancy has identified 159 "Natural Areas" in the Pennsylvania ORBES region (see Appendix A). These areas are by definition: a.) sites for basic scientific research, b.) environmental quality baseline study areas, c.) places providing guidance in land use, d.) habitats for reserves of breeding stock biota, e.) outdoor classrooms for ecology, and f.) protected areas of natural beauty (102). Many of these natural areas are located on State Game Lands, State Forests, or the Allegheny National Forest; others are located on privately owned land which may or may not be protected from degradation. Irregardless of ownership, these sites merit prime consideration in the assessment of any potentially adverse environmental impacts. The most significant of these natural areas are mapped on two plates (IV-22 and IV-17) of the Pennsylvania, "Comprehensive Water Quality Management Plan" for study areas 8 and 9 respectively (103, 104).

TABLE 2.1.4.-22

STATE AND NATIONAL PARK LAND OF THE PENNSYLVANIA ORBES REGION

County	Name of Park	Acreage	Park Type[1]
ALLE	Allegheny Islands*	139	S
	Point State Park	36	H
ARMS	Crooked Creek	2,440	S
BEAV	Raccoon Creek	6,909	S
BUTL	Moraine	15,838	S
CAMB	Prince Gallitzin	6,249	S
CAMB-FAYE-SOME-WEST	Laurel Ridge	15,426	S
CLAR-FORE-JEFF	Cook Forest	6,418	S
CLEA	Curwensville	2,118	S
	Parker Dam	895	S
	S.B. Elliott	330	S
ELK	Bendigo	100	S
	Elk	3,192	S
FAYE	Fort Necessity	912	U
FAYE-SOME	Ohiopyle	18,443	S
GREE	Ryerson Station	1,104	S
INDI	Yellow Creek	2,822	S
JEFF	Clear Creek	1,209	S
LAWR	McConnell's Mills	2,512	S
MERC	Maurice K. Goddard	4,883	S
SOME	Babcock	54	P
	Kooser	170	S
	Laurel Hill	3,935	S
	Mount Davis	581	N
	Mount Davis	10	P
VENA	Allegheny River*	3,165	S
	Oil Creek*	7,001	S
WASH	Hillman*	3,780	S
WEST	Keystone	1,187	S
	Laurel Mountain	493	S
	Laurel Summit	15	P
	Linn Run	560	S
	Mountain Streams**	8,000	S
TOTAL		120,930	

*Under design or development
**Under acquisition

[1] Key: S-State; P-State Forest Picnic Area; N-Natural Area; U-National; H-Historical

SOURCE: Pa. Bureau of Statistics, Research, and Planning (99).

REFERENCES

1. V.C. Schepps. Pennsylvania and the Ice Age. Harrisburg: Pa. Geol. Survey, 1962, Geological Survey Educational Series No. 6.

2. C.E.P. Brooks. Climate through the Ages. New York: McGraw-Hill Book Co., Inc., 1949.

3. P.B. Sears. "Postglacial Migration of Five Forest Genera." American Journal of Botany 29 (1942): 684-91.

4. L.D. Potter. "Post-glacial forest sequence of north-central Ohio." Ecology 28 (1947): 396-417.

5. P.B. Sears. "Forest sequence and climatic change in northeastern North America since early Wisconsin time." Ecology 29 (1948): 326-333.

6. L.E. Braun. Deciduous Forests of Eastern North America (reprint of original). New York: Hafner Press, 1974.

7. E.N. Transeau. "The Prairie Peninsula." Ecology 16 (1935): 423-37.

8. J.F. Lovell. Guide to Plants of the Jennings Blazing Star Nature Reserve - Butler County, Pocket Guide No. 4, Pittsburgh: Western Pennsylvania Conservancy, 1965.

9. O.E. Jennings and A. Avinoff. Wild Flowers of Western Pennsylvania and the Upper Ohio Basin. Pittsburgh: University of Pittsburgh Press, 1953.

10. F.W. Preston. "Introduction to Glacial Lake Arthur: Lake deposits and physiographic features." Guidebook for the Sixteenth Annual Field Conference of Pennsylvania Geologists (mimeographed), Dept. of Geology, University of Pittsburgh, 1950.

11. P.B. Sears. "Xerothermic Theory." The Botanical Review 8 (1942): 708-36.

12. A.W. Kuchler. Potential Natural Vegetation of the Coterminous United States. Special Publication 36, American Geographical Society, 1964.

13. G.M. Day. "The Indian as an Ecological Factor in the Northeastern Forest." Ecology 34 (1953): 327-46.

14. D.A. Marquis. The Allegheny Hardwood Forests of Pennsylvania. USDA Forest Service General Technical Report NE - 15, Upper Darby, Pa., 1975.

15. J.S. Illick. The Forest Situation in Pennsylvania. Pennsylvania Dept. of Forestry Bulletin 30, Harrisburg, 1923.

16. A.F. Hough and R.D. Forbes. "The Ecology and Silvics of Forests in the High Plateau of Pennsylvania." Ecol. Monogr. 13 (1943): 299-320.

17. S.J. Buck and E. Buck. The Planting of Civilization in Western Pennsylvania. Pittsburgh: University of Pittsburgh Press, 1939.

18. W.C. Grimm. The Trees of Pennsylvania. Harrisburg: Stackpole and Heck, Inc. 1950.

19. S.A.Wilhelm. "History of the Lumber Industry of the Upper Allegheny River Basin during the Nineteenth Century." Ph.D. dissertation, University of Pittsburgh, Pittsburgh, 1953.

20. Pennsylvania Department of Forests and Waters. "Biennial Report 1948-50." Harrisburg, Pa., 1950.

21. Pennsylvania Department of Commerce. Pennsylvania Forest Industry Statistics. Harrisburg, Pa., 1967.

22. R.V. Reynolds and A.H. Pierson. Lumber Cuts of the United States. U.S.D.A. Bulletin No. 1119, Washington, D.C., 1923.

23. U.S. Forest Service, Northeastern Forest Experimental Station, Upper Darby, Pa. Private Communication, April 27, 1978.

24. J.T. Bones and J.K. Sherwood. Primary Wood-Product Industries of Pennsylvania. U.S.D.A. Forest Service Resource Bulletin NE-27, Upper Darby, Pa., 1972.

25. R.H. Ferguson. The Timber Resources of Pennsylvania. U.S.D.A. Forest Service Resource Bulletin NE-8, Upper Darby, Pa., 1968.

26. E.L. Little. "A Check List of Native and Naturalized Trees of the United States (including Alaska)." U.S. Dept. Agr., Agr. Handbook No. 41, 1953.

27. U.S. Army Corps of Engineers, Office of Appalachian Studies. Development of Water Resources in Appalachia. Main Report II - Sub-Regional Plans, Chap. 11, 46: 25. Cincinnati, 1969.

28. J.S. Illick. A Guide to Forestry, Book I. Pennsylvania Department of Forestry Bulletin No. 26, Harrisburg, Pa., 1922.

29. Pennsylvania Department of Forests and Waters. Departmental records for 1934 and 1947. In: The Pennsylvania Manual. B. Focht (ed.), Harrisburg, Pa., 1934 and 1947.

30. U.S. Forest Service. Forest Survey Statistics for Pennsylvania. Upper Darby, Pa., 1951.

31. U.S.D.A. Soil Conservation Service. Departmental records for 1958, 1968, and 1974. In: Pennsylvania Statistical Abstracts. Pennsylvania Dept. of Commerce, Bureau of Statistics Research and Planning, Harrisburg, Pa., 1977.

32. K.S. Erdman and P.G. Wiegman. Preliminary List of Natural Areas in Pennsylvania. Pittsburgh: Western Pennsylvania Conservancy, 1974.

33. U.S. Army Corps of Engineers, Pittsburgh District. Allegheny River, Pennsylvania (mile 0 to mile 72), Final Environmental Statement on the Operation and Maintenance of the Navigation System. Pittsburgh, 1975.

34. U.S. Army Corps of Engineers, Pittsburgh District. Monongahela River, Pennsylvania and West Virginia, Draft Environmental Statement on the Operation and Maintenance of the Navigation System. Pittsburgh, 1975.

35. U.S. Forest Service, Northeastern Forest Experiment Station. Map of the Major Forest Types in Pennsylvania. Upper Darby, Pa., 1955.

36. Smithsonian Institution. "Report on Endangered and Threatened Plant Species of the U.S." House Document 94-51. Serial No. 94A. Washington, D.C., 1975.

37. H.A. Gleason and A. Cronquist. Vascular Plants of the Northeastern United States and Adjacent Canada. New York: D. Van Nostrand Co., 1963.

38. The Federal Register. "Fauna and Flora" Vol. 40, No. 127, July 1975, pp. 2783-2792.

39. Carnegie Museum of Natural History, Department of Botany. Unpublished herbarium records. Pittsburgh, Pa., 1978.

40. U.S. Environmental Protection Agency. Methods for Identifying and Evaluating the Nature and Extent of Nonpoint Sources of Pollutants. Washington, D.C., 1973.

41. Green International, Inc. Existing Population, Economy and Land Use of Study Area 9 (prelim. draft). Prepared for the Pa. Dept. of Environ. Resources by Green Int. of Sewickley, Pa., 1976.

42. Pennsylvania Department of Environmental Resources. Sub-basin 17 - State Water Plan (draft copy). Harrisburg, Pa., 1977.

43. The Copeland Report - A National Plan for American Forestry, Vol. 1, Senate Resolution 175, 72nd Congress, pp. 378-395, 1933.

44. U.S. Army Corps of Engineers, Office of Appalachian Studies. Development of Water Resources in Appalachia. Main Report II - Sub-Regional Plans, Chap. 11, 46: 25. Cincinnati, 1969.

45. Pennsylvania Fish Commission. Pennsylvania Reptiles and Amphibians, 3rd ed., M.G. Netting and N.D. Richmond (eds.), Harrisburg, Pa., 1950.

46. R. Conant. A Field Guide to Reptiles and Amphibians. Boston: Houghton Mifflin Co., 1958.

47. W.F. Blair et al. Vertebrates of the United States. 2nd ed., New York: McGraw-Hill Co., 1968.

48. U.S. Army Corps of Engineers, Pittsburgh District. Environmental Resource Inventory (draft material). Pittsburgh, 1977.

49. H.K. Reinert and P.L. Dalby. "Distributional Patterns of Pennsylvania Herpetofauna," Manuscript under preparation at the Biology Department of Clarion State College, Clarion, Pa., 1978.

50. Pennsylvania Fish Commission, Division of Herpetology and Endangered Species, Bellefonte, Pa. Private Communication July 25, 1978.

51. Pennsylvania Fish Commission. "New List of Endangered, Threatened, or Status Indeterminate Fishes, Amphibians, and Reptiles." Bellefonte, Pa., 1977.

52. Pennsylvania Fish Commission. Summary of Fishing Regulations and Laws - 1978. Harrisburg, 1978.

53. Carnegie Museum of Natural History, Department of Herpetology. Pittsburgh, Pa., Private Communication June 25, 1978.

54. Based upon the collecting experience of the author between 1964 and 1978.

55. Pennsylvania Department of Agriculture, Division of Zoology. The Serpents of Pennsylvania. IV (4, 5), Harrisburg, 1906.

56. Green International, Inc. Environmental Characteristics of Study Area 8 (preliminary draft). Chap. IV, Comprehensive Water Management Plan (COWAMP) prepared for the Pa. Dept. of Environ. Resources by Green International, Sewickley, Pa. 19

57. J.K. Bowler. "Venomous Snakes of Pennsylvania." Pennsylvania Game News 45(7), 1974.

58. Carnegie Museum of Natural History, Department of Environmental Science. Pittsburgh, Pa., Private Communication January 24, 1978.

59. Pennsylvania Fish Commission, Division of Herpetology and Endangered Species, Bellefonte, Pa., Private Communication July 28, 1978.

60. Pennsylvania Game Commission and the National Audubon Society. Proceedings of the Symposium on Nongame Species October 1, 1977. T. Williams (ed.), Harrisburg, Pa., 1978.

61. G. Laycock. America's Endangered Wildlife. New York: W.W. Norton and Co., Inc., 1969.

62. W.E.C. Todd. Birds of Western Pennsylvania. Pittsburgh: University of Pittsburgh Press, 1940.

63. J.A. Allen. Bulletin Museum Comparative Zool. 2: 375-425, 1871.

64. C.H. Merriam. Nat. Geogr. Mag. 6: 229-238, 1894.

65. Pennsylvania Department of Environmental Resources. Sub-basin 16-State Water Plan (draft copy). Harrisburg, Pa., 1977.

66. Pennsylvania Department of Environmental Resources. Sub-basin 20 - State Water Plan (draft copy). Harrisburg, Pa., 1977.

67. L.A. Luttringer. Pennsylvania Birdlife. 7th ed., Harrisburg, Pa.: Pennsylvania Game Commission, 1973.

68. Pennsylvania Game Commission, Department of Information and Education. "Hunting in Southwestern Pennsylvania." Harrisburg, Pa., 1976.

69. Pennsylvania Game Commission, Department of Information and Education. "Hunting in Northwestern Pennsylvania." Harrisburg, Pa., 1976.

70. H. Palmer. Environmental Impact Review Manual. Harrisburg: Pennsylvania Game Commission, 1977.

71. R. Gerstell. The Pennsylvania Bounty System. Research Bulletin No. 1. Harrisburg: Pa. Game Commission, 1937.

72. S.P. Baldwin, S.C. Kendeigh, and R.W. Franks. "The protection of hawks and owls in Ohio." Ohio Jour. Sci. 32(5): 403-424, 1932.

73. M.E. Rutzmoser and D.S. Heintzelman. "Peregrines and pesticides - the extinction of a species." Pa. Game News 41(6), 1970.

74. H. Mayfield. The Kirtland's Warbler. Bloomfield Hills, Michigan: Cranbrook Inst. of Science, 1960.

75. Pennsylvania Game Commission, Waterfowl Mgmt. Station, Pymatuning Reservoir. Private Communication July 20, 1978.

76. American Birds 31: 3-23.

77. W.C. Grimm and R. Whitebread. Mammal Survey of Northeastern Pennsylvania. Harrisburg: Pa. Game Commission, 1952.

78. R.M. Gilmore. "Mammals in archaeological collections from southwestern Pennsylvania." Journ. Mamm. 27(3): 227-334.

79. J.K. Doutt, C.A. Heppenstall, and J.E. Guilday. Mammals of Pennsylvania. R.M. Latham (ed.). Harrisburg: Pa. Game Commission, 1966.

80. R.B. Simpson. "Mammals of Warren County, Pennsylvania." Unpublished field notes; a copy is on file at the Allegheny National Forest Station, Warren, Pa., 1890-1944.

81. H.E. Clepper. The Deer Problem in the Forests of Pennsylvania. Pa. Dept. of Forests and Waters Bulletin No. 50, Harrisburg, 1931.

82. Compiled from various issues of Pennsylvania Game News from 1971 to 1977.

83. C. Fergus. "A Wasted Harvest." Pennsylvania Game News, Vol. 45(10), Harrisburg, 1974.

84. W.C. Grimm and H.A. Roberts. Mammal Survey of Southwestern Pennsylvania. Harrisburg: Pa. Game Commission, 1950.

85. N.D. Richmond and H.R. Rosland. Mammal Survey of Northwestern Pennsylvania. Harrisburg: Pa. Game Commission, 1949.

86. L.A. Luttringer, Jr. An Introduction to the Mammals of Pennsylvania. Harrisburg: Pa. Game Commission, 1931.

87. T. Eveland and L. Rymon. "Pennsylvania Otter Study." In: Proceedings of the Symposium on Nongame Species Oct. 1, 1977. T. Williams (ed.). Harrisburg: Pa. Game Commission, January 1978.

88. Pennsylvania Game Commission, Department of Information and Education. "Mammals Conservation Fact Sheet." Harrisburg, Pa.

89. Pennsylvania Department of Environmental Resources, Bureau of Forestry. Private Communication. Harrisburg, Pa. June 21, 1978.

90. Pennsylvania Game Commission. A Digest of Pennsylvania Hunting and Trapping Regulations. Harrisburg, Pa., 1977.

91. Pennsylvania Bureau of Maps. Pennsylvania County Maps and Recreational Guide. Kaukauna, Wisconsin: Thomas Publications - Hartjes Center, 1978.

92. Pennsylvania Game Commission. Twenty-five Well-Known Pennsylvania Mammals. Harrisburg, Pa., 1954.

93. T. Godshall. "A New Approach to Elk Management." Pennsylvania Game News, Harrisburg, Pa., 1976.

94. Pennsylvania Game Commission. "Annual Report of the Board of the Commonwealth of Pennsylvania for the Year 1921." Harrisburg, Pa., 1922.

95. R.M. Latham. The Ecology and Economics of Predator Management. Report No. 2 of the Pittman - Robertson Project 36-R. Harrisburg: Pa. Game Commission, 1951.

96. Pennsylvania Game Commission. "Bobcat" Game Conservation Wildlife Note 175-3. Harrisburg, 1975.

97. Pennsylvania Game Commission. Pennsylvania Game News. 48(7), Harrisburg, 1977.

98. Pennsylvania Game Commission, Department of Information and Education. Harrisburg, Pa.

99. Pennsylvania Department of Commerce, Bureau of Statistics, Research, and Planning. Pennsylvania Statistical Abstracts. 19th ed., Harrisburg, Pa., 1977.

100. Green International, Inc. "State/Federal Recreation Areas" Plate IV-21, COWAMP Study Area 8. Prepared for Pa. Dept. of Environ. Resources by Green Intern. of Sewickley, Pa., 1975.

101. Green International, Inc. "State/Federal Recreation Areas." Plate IV-19, COWAMP Study Area 9. Prepared for Pa. Dept. of Environ. Resources by Green Int. of Sewickley, Pa. 1975.

102. Illinois Nature Preserves Commission. Comprehensive Plan for the Illinois Nature Preserves System, Part I - Guidelines. Rockford, Ill., 1972.

103. Green International, Inc. "Conservation Map" Plate IV-22, COWAMP Study Area 8. Prepared for Pa. Dept. Environ. Resources by Green Intern. of Sewickley, Pa., 1975.

104. Green International, Inc. "Conservation Map" Plate IV-17, COWAMP Study Area 9. Prepared for Pa. Dept. Environ. Resources by Green Intern. of Sewickley, Pa., 1975.

2.1.5. SURFACE HYDROLOGY

2.1.5.1. HISTORICAL CONSIDERATIONS

A. Prehistoric Surface Hydrology

Prior to the first Pleistocene glaciation (Nebraskan), western Pennsylvania was drained by three northerly flowing rivers which emptied into an extension of the St. Lawrence River*. The western-most basin consisted of the Allegheny River south of Clarion, the Beaver, Monongahela, and Grand Rivers. The resulting waterway, often termed the Monongahela-Beaver or Pittsburgh River, emptied into the St. Lawrence at what is now the shore of Lake Erie between Ashtabula and Geneva-on-the-Lake. The central waterway, the Old Middle Allegheny, consisted of the Allegheny main stem from Emlenton to Franklin, Conneaut Creek, French Creek, and Crooked Creek; its direction of flow was northwest between the Ohio line and modern day Girard (1). The third preglacial waterway, the Old Upper Allegheny, flowed from south of Warren by way of the Chautauqua depression (2, 3, 4).

The arrival of glaciers in northern Pennsylvania brought ice and glacial debris which dammed the northward flowing streams and caused them to reverse their flow. The most significant break to the south occurred in the vicinity of New Martinsville, West Virginia. The divide in this area which formerly contained the headwaters of the ancestral Ohio River was cut through and the waters of western Pennsylvania were re-routed to the Mississippi Valley. Netting (2) believes that the modern day drainage pattern was established by pre-Illinoian or Illinoian glaciation rather than by the Wisconsin as some writers claim. It is known that during the last interglacial period (Sangamor), a great deepening occurred in the Upper Ohio valleys. Figure 2.1.5.1 illustrates the probable preglacial drainage pattern along with the present system.

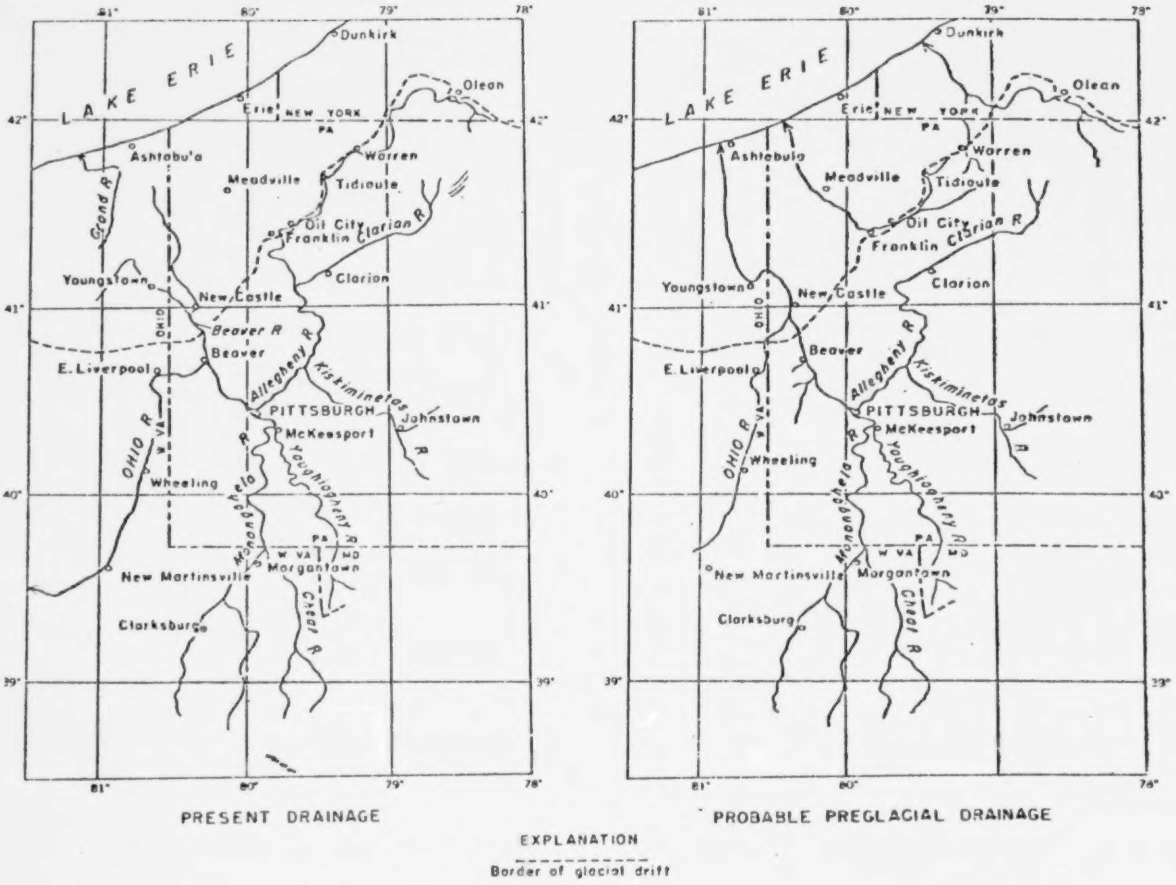
Noecker et al (3) note that these prehistoric changes in basin conformation

---

*At this time, the Great Lakes had not yet formed and the St. Lawrence flowed along its present day axis.

F I G U R E 2.1.5. - 1

PRESENT AND PROBABLE PREGLACIAL DRAINAGE PATTERNS OF WESTERN PENNSYLVANIA


81°
80°
79°
78°
42°
41°
40°
39°
LAKE ERIE
Dunkirk
Olean
Erie
NEW YORK
PA
Ashtabula
Warren
Meadville
Tidioute
Grand R
Oil City
Franklin
Clarion R
Clarion
Youngstown
New Castle
OHIO
Beaver R
Beaver
E. Liverpool
Allegheny R
Kiskiminetas
PITTSBURGH
Johnstown
McKeesport
R
OHIO R
W VA
Wheeling
Monongahela
Youghiogheny R
PA
MD
W VA
New Martinsville
Morgantown
Cheat R
Clarksburg

PRESENT DRAINAGE

PROBABLE PREGLACIAL DRAINAGE

EXPLANATION

Border of glacial drift

SOURCES: Noecker _et al_ (3); Leverett (4).

are of great significance in the occurrence and present distribution of the highly productice alluvial deposits of the Pittsburgh vicinity. The aforementioned changes are largely responsible for the presence of valley fill materials in the Allegheny and Ohio River valleys which are conducive to the development of large ground water supplies.

B. General Historical Characteristics

The aesthetic appeal of a waterway, although difficult to qualify and impossible to quantify, is inextricably linked to hydrologic variables. Basic physical characteristics such as stream velocity, flow, meander pattern, gradient, and overall basin morphology enter into man's appraisal of beauty perhaps even more than the chemical quality and biological diversity of flowing waters. The earliest descriptions of the Upper Ohio consist chiefly of aesthetic appraisals.

The Frenchman LaSalle is credited with having been the first European to discover the Ohio River (circa 1670). The French, who considered the Allegheny and Ohio to be the same river, named the waterway "La Belle Riviere," or the beautiful river. Much controversy surrounds the origin of this name. American Indians referred to the river as "Oyo" a word which the French thought was derived from the Iroquois word "oyoneri," meaning beautiful. However, John Heckewelder, a Moravian missionary of the eighteen century, later theorized that the French had erred in their translation and that "Oyo" was actually a form of "Ohiopeekhanne," the Miami Indian word for "white foaming river" (5). Heckewelder noted that southwesterly winds were capable of producing "white caps" severe enough to prevent canoe travel. References to the wind occur in other historical pieces of literature. Douglas Southall Freeman, a biographer of George Washington, described Pittsburgh as "the windswept uninhabited point of land where the turbulent Allegheny received the waters of the slow, powerful and silent Monongahela..." (6).

Regardless of the etymology of the rivers' name, the waterways of western Pennsylvania were indeed appealing in pre-settlement and settlement times.

Celoron de Bienville, a chevalier commanding a military detachment in 1749, was the first European to sail on the Ohio. He described the area in the vicinity of the modern day "Point" as being the fairest spot along La Belle Riviere. George Washington was also enthralled with the waterways in this area ,although chiefly from a strategic perspective (5).

Perhaps the most romantic description of the Ohio Basin can be found in the writings of the famous naturalist, John James Audubon, who made a float trip from Pittsburgh to Louisville in 1808. Twenty years later, Audubon reflected on his excursion and the changes occurring in the river valley since that time (6).

> Nature, in her varied arrangements, seems to have felt a partiality towards this portion of our country. As the traveler ascends or descends the Ohio he cannot help remarking that, alternately, nearly the whole length of the river on one side is bounded by lofty hills and a rolling surface; while on the other extensive plains of the richest alluvial land are seen as far as the eye can command the view. Islands of varied size and form rise here and there from the bosom of the water, and the winding course of the stream frequently brings you to places where the idea of being on a river of great length changes to that of floating on a lake of moderate extent...Purer pleasures I have never felt; nor have you, reader...
>
> When I think of these times, and call back to my mind, the grandeur and beauty of those almost uninhabited shores; when I picture to myself the dense and lofty summits of the forest, that everywhere spread along the hills and overhung the margins of the stream...When I reflect that all this...is now more or less covered with villages, farms, and towns...that steamboats are gliding to and fro over the whole length of the majestick river, forcing commerce to take root and to prosper at every spot...when I see the surplus population of Europe coming to assist...and transplanting civilization into its dark recesses...when I remember that these extraordinary changes have all taken place in a short period of twenty years I pause, I wonder, and although I know all to be the fact can scarcely believe its reality.

C. Historical Description - Channels and Hydraulics

Prior to the undertaking of slackwater navigation improvements by the U.S. Army Corps of Engineers, the Allegheny, Monongahela, and Ohio Rivers were known to have harbored numerous physical impediments to water based transportation.

Wiley (7) notes that numerous snags (i.e. fallen trees and boulders), in addition to many shallow areas resulting from sandbar or shoal formation, constituted major hazards to early navigation. In his classic work, The Navigator, riverman Zadock Cramer (8) emphasized the need to remove the abundant "rocks and ripples" in the reach of the Ohio River between Pittsburgh and Mingo Town (downstream of modern day Steubenville).

Along each of the "Three Rivers," depth and current velocity varied substantially. References indicate that the rivers consisted of alternating reaches of sluggish, deep pools and extremely shallow riffles or rapids with powerful currents (9, 10). The crews of early cargo boats employed long poles to move upstream in the deep reaches; however, crude winching techniques were often required to perform the same task in fast, shallow water. Historical evidence also suggests that all three rivers could be waded during normal flows, especially at areas downstream of major tributaries, where natural deltas formed at the mouth of tributary streams.

The Corps of Engineers (9, 10) describe the physical characteristics of the Allegheny and Monongahela Rivers prior to channelization as follows:

> One of the earliest, if not the first, recorded survey of the Allegheny Rivers was performed by Lieutenants C. Graham and J.M. Berrien (1828)(11). At that time, river widths varied from a maximum of about 1,200 feet towards the mouth, to an average of about 1,050 feet in the vicinity of the Kiskiminetas River, and eventually to about 550 to 900 feet towards the upstream limit of the present slackwater navigation improvements. Islands were present at normal intervals of 3 to 5 miles throughout most of the reach. Riffles and sandbars or shoals were not shown on the survey, but presumably they existed. The meander pattern was relatively gentle in the lower portion of the reach, becoming more pronounced in the upstream portion as is in evidence yet today,
>
> The first recorded survey of the Monongahela River was performed in 1833 under the direction of Dr. William Howard, U.S. Civil Engineer (12). At that time, the river rapidly narrowed in width from about 1,300 feet near the mouth to about 600 feet near the mouth of the Youghiogheny River (r.m.* 15.5). Between the mouth of the Youghiogheny River

---

*r.m. - river mile.

> and the upstream limit of the survey at Brownsville (r.m. 55), the river varied between 300 and 600 feet in width. Numerous ripples, shoals and bars were noted at intervals averaging slightly over 2 miles, but commonly varying in spacing from over 3 to less than 1 mile. The river survey bears out Wiley's contention (7), based on other historical observations, of the Monongahela's almost complete lack of islands compared with the upper Ohio and Allegheny Rivers. The river meander pattern was relatively gentle as is in evidence yet today.

J.K. Hoskins, sanitary engineer and contributing author to the well-known "Study of the Pollution and Natural Purification of the Ohio River " (13), rendered the following account of channel characteristics of the Ohio main stem in the early twentieth century.

> The Ohio is largely an alluvial stream in a fairly advanced stage of channel adjustment, as is evidenced by the fact that the velocities of flow are quite uniform throughout the length of the channel, and also by the fact that the meanders of the line of flow are gradual and wide-sweeping. The stiff clay soil has, however, brought about an adjustment to high rather than to low discharges, resulting in a channel floor that is relatively wide and flat... The river bed in the upper reaches consists of coarse gravel and boulders, but in passing downstream these are gradually replaced by sand and silt deposits. The channel is made up of a series of pools and riffles, alternating with stretches of rather smooth, uniform grade. The depth of the water in the pools at low stages ranges from less than 10 feet to over 50 feet, while in the riffles, especially in the upper part of the river, the depths are frequently less than 3 feet at low-water stages.
>
> The slope of the river, as measured by the elevation of the water surface, decreases gradually from 11.4 inches per mile between Pittsburgh and Wheeling to 3.7 inches per mile in the last 70 miles above its mouth...
>
> From Pittsburgh to Cincinnati, the channel is narrow and comparatively uniform in width, ranging from 1,200 feet to 1,500 feet at low water.

D. Historical Flow Variation

The Allegheny, Monongahela, and upper Ohio Rivers are all known to have exhibited large variation in flow prior to channelization. River traffic was often halted due to low flows that persisted for weeks and sometimes months, typically in the late summer and early fall (7). During low flow conditions in the reach of the Ohio River upstream of Louisville, the worst shoals are known to have had minimum depths of one foot of water flowing over them. Even downstream of Louisville, such shoals had minimum depths of a mere two feet. The results of these conditions were disastrous to navigation since a minimum depth of three feet over bad shoals was deemed to be necessary for steamboats and river craft of cargo size (6).

Flooding, because of its devastating impacts upon civilization, has been especially well documented for the upper Ohio River Basin. The Pittsburgh area is known to have been traumatized by floods since the beginnings of its settlement. References to flooding extend back in time to 1756 in letters emanating from the French-occupied Fort Duquesne. The first recorded crest is from the January flood of 1762 and records exist for fifteen additional floods before 1885. Although the cutting of forests and draining of swamps are believed to have intensified the flooding problem in recent years, the available historical data indicates that flooding has always been a problem in this region. In 1763, before a single swamp was drained, the Ohio River crested at a modern height equivalent of 44 feet at "the Point" in Pittsburgh (6). The downstream results of this flood prompted the Shawnee Indians to relocate their main village from the mouth of the Scioto River to Chillicothe, Ohio.

Throughout the nineteenth century, even the ordinary high waters of late winter and early spring posed a significant threat to navigation since such flows often carried swiftly moving ice flows. Further discussion of the history of floods is included in Section 2.1.5.3, B.

E. Human Modification of the River System

By an Act of Congress approved on May 24, 1824, the U.S. Army Corps of Engineers was given the authority to remove the "planters, sawyers, and snags" from the channel of the Ohio River. Snagging and clearing operations were also carried out on the Monongahela River at this time. The Allegheny River, however, did not receive any extensive attention until the latter portion of the 19th century.

The earliest attempts at improving navigation consisted of the construction of stone wingwalls in the rivers. These structures served to concentrate stream flow and thereby increase water depth in the rapids. Later, towards the middle of the 19th century (1839-1886), the Monongahela Navigation Company built Locks and Dams Nos. 1-7 on the Monongahela River. These structures, essentially the first slackwater locks and dams of the Pittsburgh area, generally provided a lift of less than ten feet.

In 1875 a proposal emerged to provide a minimum channel depth of 6 feet in the Ohio main stem. The proposed task was to be accomplished by the construction of 68 movable dams. The first of these was constructed in the fall of 1885 at Davis Island (r.m. 4.7). Although this initial structure only maintained an upper pool elevation of 703.0 feet above mean sea level (msl), the City of Pittsburgh is reported to have had ample harbor space even during low flow conditions (6, 13).

It is a generally accepted fact that the expansion of railroads during the latter portion of the nineteenth century had a substantial impact on public opinion of river based transportation. People began to view the waterways as an inefficient and outmoded means of travel. Consequently, Banta (6) has labeled the period from 1885-1922 as a time of stagnation in the plans for channelization of the Ohio. Nonetheless, a real flurry of construction activity occurred in the Pittsburgh area during the turn of the century. Between 1874 and 1903, slackwater navigation was extended to the head of the Monongahela River by the construction of Locks and Dams Nos. 8-15; and in 1897, the U.S. Government acquired Locks and Dams Nos. 1-7 from the Monongahela Navigation Company. Between 1894 and 1902, Lock and Dam No. 1 was constructed on the Allegheny River at mile 1.7. Construction of Allegheny L/D Nos. 2 and 3 followed between 1898 and 1908. In addition, the following locks and dams were constructed on the upper Ohio: Lock and Dam No. 2 (r.m. 9.0) from 1898-1906; L/D No. 3 (r.m. 10.9) from 1899-1907; L/D Nos. 4, 5 and 6 (r.m. 18.6, 23.9 and 28.8 respectively) from 1892-1908; and L/D Nos. 7, 8, and 9 (r.m. 36.9, 46.1 and 55.6 respectively) from 1904-1914.

Throughout the twentieth century various modifications of the slackwater navigation system have taken place. The general trend has been to reduce the number of separate structures, replacing several at a time with a single larger structure. The Emsworth Locks and Dams, constructed on the Ohio in 1921, replaced the Davis Island Lock and Dam and Ohio River L/D No. 2. In 1938, when Emsworth Pool was raised by 7 feet by dam reconstruction. Allegheny River L/D No. 1 and Monongahela River L/D No. 1 were also eliminated at that time. In addition, the Dashields Locks and Dams replaced Ohio River L/D No. 3 in 1929; the Montgomery Locks and Dams replaced Ohio River L/D Nos. 4, 5 and 6 in 1936; and the New Cumberland Locks and Dam replaced Ohio River L/D Nos. 7, 8, and 9 in 1960.

Various Allegheny and Monongahela structures were reconstructed and/or moved. Among these were the Monongahela L/D Nos. 2 and 3, built at new locations in 1934 and Allegheny L/D Nos. 2-6 (Nos. 2-5 were moved to new sites.) The original Allegheny L/D Nos. 7, 8 and 9 were replaced by new L/D Nos. 7 and 8 at new sites in 1925.

The series of locks and dams in use (see Tables 2.1.5.-3, 2.1.5.-7, and 2.1.5.-10) have significantly altered the channel and hydraulic characteristics of each river. The effect of these structures has been to create almost constant river stages within each pool in spite of wide range of river flows. Slight increases in river widths and substantial increases in river depths have resulted from empooling large reaches. The degree of water level fluctuation within a navigation pool is largely the result of the type of dam utilized. Gated dams, which predominate in the Monongahela and Upper Ohio, maintain relatively stable pool elevations whereas fixed crest dams permit water level fluctuation.

Each of the "Three Rivers" are dredged as necessary in order to maintain the navigable channel at a minimum depth of 9 feet. The Corps of Engineers contracts the majority of this work to private companies.

2.1.5.2. THE "THREE RIVERS" AND THEIR BASINS

A. The Monongahela River Basin

1. General Description

The Monongahela River, or "Mon" as it is colloquially known, is formed by the confluence of the West Fork River and Tygart Valley River at Fairmont, West Virginia. From its source, the Monongahela flows in a northerly direction of 128.7 miles to Pittsburgh, Pennsylvania where it meets the Allegheny to form the Ohio. Although 71% or 91.6 miles of the Monongahela's total length is contained within Pennsylvania, only 37% of the 7,384 square mile drainage area lies within the geographic confines of the state. West Virginia is home to the majority of the basin (4,228 sq. mi.), while Maryland accounts for a mere 420 square miles of drainage area. Figure 2.1.5.-2 maps the geography of the total basin.

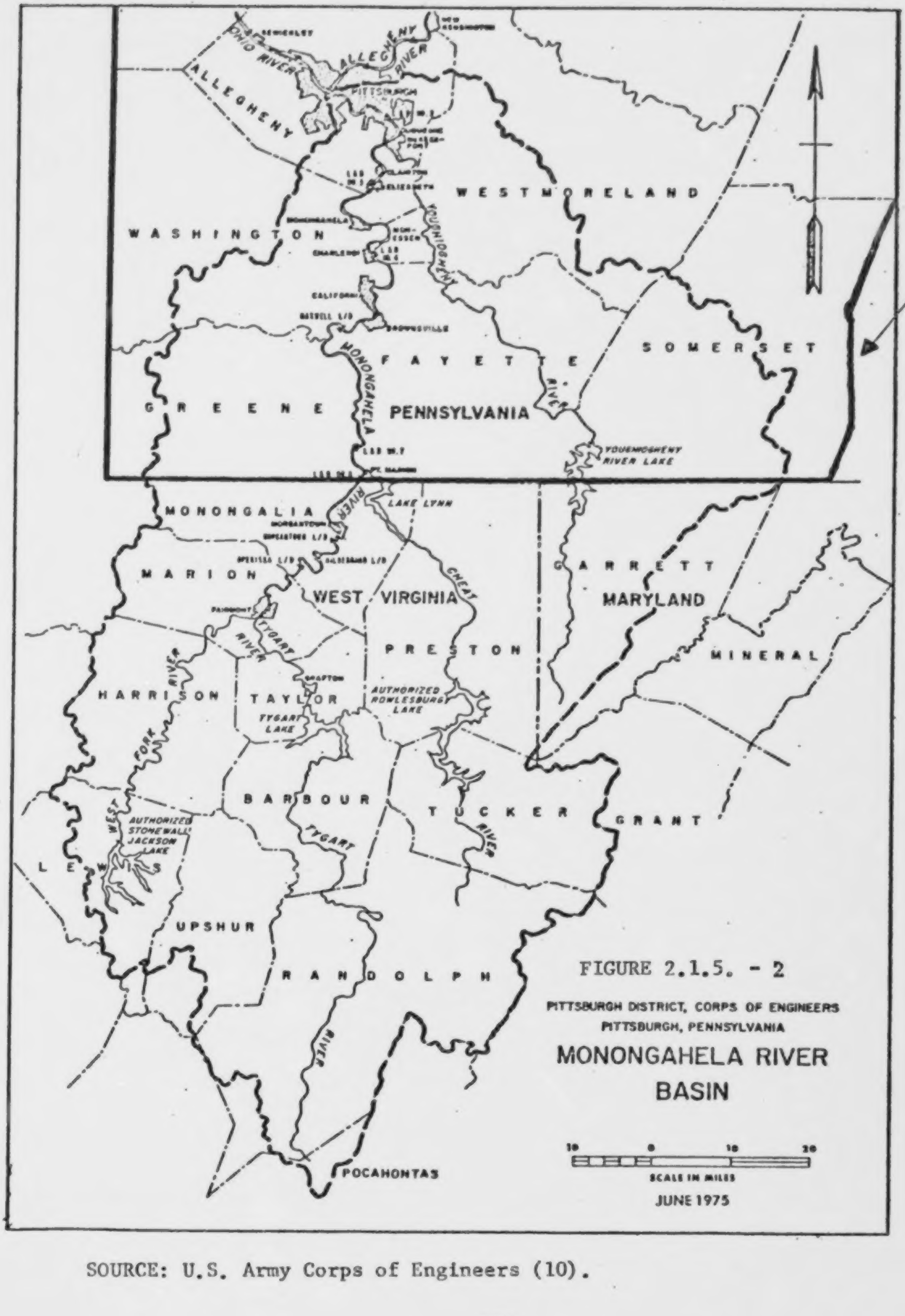
2. Basin Configuration

Hydrologically, the Monongahela Basin is bordered by the Ohio River main stem drainage to the west, by the Little Kanawha and Kanawha River drainage to the south, by the Potomac River drainage to the east, and by the Allegheny River drainage to the north. The entire Monongahela Basin is approximately 130 miles long (north to south) and 75 miles wide (east to west).

Geopolitically, the Monongahela Basin within Pennsylvania (Pa. DER Sub-basin #19) is triangular in shape and contains the following ORBES counties: all of

Figure 2.1.5-2

Map of Monongahela River Basin


OHIO RIVER
ALLEGHENY RIVER
ALLEGHENY
SEWICKLEY
NEW KENSINGTON
PITTSBURGH
ELIZABETH
MONONGAHELA
CHARLEROI
CALIFORNIA
BROWNSVILLE
WESTMORELAND
WASHINGTON
YOUGHIOGHENY
FAYETTE
SOMERSET
GREENE
PENNSYLVANIA
MONONGAHELA
RIVER
YOUGHIOGHENY RIVER LAKE
LAKE LYNN
MONONGALIA
MORGANTOWN
MARION
CHEAT
WEST VIRGINIA
GARRETT
MARYLAND
FAIRMONT
TYGART
RIVER
PRESTON
MINERAL
HARRISON
TAYLOR
GRAFTON
TYGART LAKE
AUTHORIZED ROWLESBURG LAKE
WEST FORK RIVER
BARBOUR
TUCKER
GRANT
TYGART
RIVER
AUTHORIZED STONEWALL JACKSON LAKE
LEWIS
UPSHUR
RANDOLPH
RIVER
POCAHONTAS
FIGURE 2.1.5. - 2
PITTSBURGH DISTRICT, CORPS OF ENGINEERS
PITTSBURGH, PENNSYLVANIA
MONONGAHELA RIVER BASIN
10
0
10
20
SCALE IN MILES
JUNE 1975

PA. ORBES REGION EASTERN BOUNDARY

SOURCE: U.S. Army Corps of Engineers (10).

Fayette; most of Greene, Washington, Westmoreland, and Somerset; and a small portion of Allegheny. In West Virginia, the basin includes all of Marion, Mongalia, Barbour, Harrison, Taylor, and Tucker counties; most of Preston, Randolph, Upshur and Lewis counties; and a small sector of northern Pocahontas County. The basin in Maryland is limited to more than half of Garrett County. Table 2.1.5.-1 presents the percentage of land in each county that is contained within the total Monongahela Basin.

3. Tributary Streams

Fifty-seven tributary streams enter the Monongahela River in Pennsylvania. The Youghiogheny River, Cheat River, and Ten Mile Creek are the largest and most hydrologically significant of these streams. The Youghiogheny drains a 1,763 square mile basin, 72% of which is contained in Pennsylvania. The upper portion of the "Yough" Basin lies in western Maryland and a small corner of eastern West Virginia. The Cheat River enters the Monongahela River at Point Marion, Pa., near the Mason-Dixon Line; consequently, less than 7% of its 1,422 square mile drainage basin is contained within Pennsylvania. Ten Mile Creek drains 338 square miles, all of which lie in western Pennsylvania. The physiographic characteristics of these three tributaries are presented in Table 2.1.5.-2.

4. Basin Physiography

The Monongahela River Basin is situated within the physiographic province known as the Appalachian Plateau, mostly in the Pittsburgh Plateaus Section, but partly in the Allegheny Mountains Section*. The portion of the basin in the Pittsburgh Section is characterized by moderate to strong relief. Erosion has imparted a slope to almost all of the land. Consequently, the area is well-drained and lacks natural lakes and extensive wetlands. Rounded hills and ridges reaching altitudes between 1,200 and 1,250 feet above mean sea level typify the region

---

*See Fig. 2.1.1.-1 of Geology Baseline

TABLE 2.1.5. - 1

COUNTIES OF THE MONONGAHELA RIVER BASIN

State	County	Percent of County Land Area in Basin
Pennsylvania	Allegheny	30.7
" "	Fayette	100.0
" "	Greene	78.7
" "	Somerset	48.8
" "	Washington	36.8
" "	Westmoreland	42.0
West Virginia	Barbour	100.0
" "	Harrison	100.0
" "	Lewis	62.5
" "	Marion	100.0
" "	Monongahela	100.0
" "	Pocahontas	3.6
" "	Preston	99.0
" "	Randolph	91.3
" "	Taylor	100.0
" "	Tucker	100.0
" "	Upshur	83.0
*Maryland	Garrett	63.8

*Not part of the ORBES Study Area

SOURCE: Fed. Wtr. Poll. Cntrl. Admin. (14).

TABLE 2.1.5.-2

PHYSIOGRAPHIC CHARACTERISTICS OF MAJOR STREAMS OF THE MONONGAHELA RIVER BASIN

Stream	Miles Above Mouth of Monongahela River	Drainage Area (sq. mi.)	Length of Stream (miles)	Slope (Feet per Mile)		
				Average	Headwater	Mouth
Monongahela River	0	7,384	128.7	1.15	1.6	0.6
Youghiogheny River	15.5	1,763	123	17.9	29.1	1.1
Ten Mile Creek	65.7	338	34.1	15.7	-	-
Cheat River	89.1	1,422	78	11.3	-	-
Tygart Valley River	128.7	1,375	131.8	19.6	32.6	9.2
West Fork River	128.7	880	99	7.5	20.6	0.96

SOURCE: U.S. Army Corps of Engineers (10).

between Pittsburgh and Washington, Pa. Southward and westward of Washington the topography is steeper with a maximum elevation of 1,600 feet in Greene County.

The upper Youghiogheny River and its tributaries drain a portion of the Allegheny Mountains Section in Fayette and Somerset Counties. This mature upland plateau of strong relief is home to three anti-clinal ridges (Chestnut Ridge, Laurel Hill and Negro Mountain) and the highest point in the state, Mt. Davis (3,213 feet above msl). The Youghiogheny River cuts through the Laurel Ridge and produces a spectacular gorge that is over 1,500 feet deep.

Stream elevations for the entire Monongahela Basin range from 4,842 feet above msl in the headwaters of the Cheat River to 6 feet above msl at the mouth of the Monongahela. The Monongahela main stem flows through a well defined river valley with steep sides rising 600-800 feet above the valley floor. In West Virginia, the valley width is narrow; however, it gradually widens to about 0.4-0.5 miles in Pennsylvania, downstream of Lock and Dam No. 7.

5. Channel Characteristics

The channel thalweg of the Monongahela main stem ranges in depth from approximately 15 to 35 feet (10). The shallower portions of the thalweg typically occur at sites immediately downstream of navigation dams, whereas thalweg depths of 25-35 feet may be found in areas directly upstream of these structures. Pool widths gradually increase in the downstream direction as follows:

	Approximate Pool Width (Feet)		
	Normal Maximum	Normal Minimum	Normal Average
Upper Monongahela	600	400	500
Lower Monongahela	1,000	700	850

Further characterization of specific pools is presented in Table 2.1.5.-3.

6. Impoundments

Within the confines of Sub-basin #19, 91 dams impound approximately 275,635

TABLE 2.1.5. - 3

CHARACTERISTICS OF MONONGAHELA RIVER NAVIGATION SYSTEM

Locks and Dams	River Mile	State	Dam Crest	Length of Pool (miles)	Upper Pool Elevation (msl)	Surface Area @ Normal Pool (acres)	Storage @ Normal Pool (acre-feet)	Mean Pool Depth (feet)	Commenced Operation
Emsworth L/D (Monongahela Arm)	6.2[1]	Pa.	Gated	11.2	710.0	1125	13,800	12.3	Sept. 1921
L/D 2	11.2	Pa.	Fixed	12.6*	718.7	1190	14,000	11.8	Aug. 1905
L/D 3	23.8	Pa.	Fixed	17.7	726.9	1595	15,800	9.9	May 1907
L/D 4	41.5	Pa.	Gated	19.7	743.5	1660	25,100	15.1	Aug. 1932
Maxwell L/D	61.2	Pa.	Gated	23.8	763.0	1875	31,000	16.5	Nov. 1964
L/D 7	85.0	Pa.	Fixed	5.8**	778.0	420	5,500	13.1	Nov. 1925
L/D 8	90.8	W. Va.	Gated	11.2	797.0	705	11,500	16.3	Oct. 1925
Morgantown L/D	102.0	W. Va.	Gated	6.0	814.0	365	6,200	17.0	Jul. 1950
Hildebrand L/D	108.0	W. Va.	Gated	7.4	835.0	405	7,600	18.8	Mar. 1960
Opekiska L/D	115.4	W. Va	Gated	13.3***	857.0	805	14,400[2]	17.9	Aug. 1964
				128.7		10,145	144,100		

1. Ohio River mileage for main channel dam.

2. Exclusive of West Fork & Tygart River Arms of the Opekiska Pool. Inclusive total storage = 17,300 acre-feet.

* Plus an additional 2.1 miles of slackwater on the Youghiogheny River.

** Plus an additional 1.5 miles of slackwater on the Cheat River.

*** Plus an additional 6.0 miles of slackwater on the West Fork and 7.6 miles on the Tygart River.

Adapted from U.S. Army Corps of Engineers (10,15).

acre-feet of water (16). Natural lakes are nonexistent in this region. In the Upper Monongahela Basin, four large reservoirs (Lake Lynn, Deep Creek Lake, Tygart Lake and Youghiogheny River Lake) drain approximately 3,100 square miles of land. Deep Creek Lake and Lake Lynn are owned by private power companies and are operated to produce peak load power of 51 and 19 megawatts, respectively. The Youghiogheny River Lake and Tygart River Lake are operated by the Corps of Engineers for flood control, recreation, low flow augmentation for water quality, and navigation. The four reservoirs contain 720,000 acre-feet of total storage. Allocated storage capacities are as follows: 250,000 acre-feet for summer flood control; 430,000 acre-feet for winter flood control; and 113,000 acre-feet of usable capacity for power generation. Table 2.1.5.-4 characterizes the individual reservoirs in greater detail.

The Corps of Engineers' Stonewall Jackson Lake on the upper West Fork River is currently (1978) in the "construction phase" (real estate procurement). This multipurpose reservoir is to be operated for water supply, low flow augmentation for water quality maintenance, and flood control. The planned gross capacity is 74,650 acre-feet. The project is not expected to have a large impact on the hydrology of the Monongahela Basin due to its small storage capacity and drainage area (102 sq. mi.). The flood control summer and winter minima are projected to be 26,480 and 38,550 acre-feet respectively. Approximately 3,120 acre-feet are planned for permanent storage. The tentative year of completion for the project is 1984 (17).

Planning of the Rowlesburg Reservoir on the Cheat River is now inactive. The projected total storage capacity of this proposed reservoir was 750,000 acre-feet. If constructed, it would have a major influence on the hydrology of the region.

T A B L E 2.1.5. - 4

MAJOR MULTIPURPOSE AND POWER GENERATION RESERVOIRS IN THE MONONGAHELA RIVER BASIN

Reservoir	Purpose[a]	Date In Operation	Drainage Area Sq. Mi.	Storage Capacity (1000 ac. ft)[b]					Minimum Release (cfs)		Operator
				Minimum	Conservation[c]	Flood Control[c]	Power	Total	Winter	Summer	
Tygart Valley River	FNR	1938	1184	9.7	0.0W 99.9S	278.0W 178.1S	-	287.7	100	100	Corps of Engineers
Youghiogheny	FLR	1948	434	5.2	97.8W 149.3S	151.0W 99.5S	-	254.0	100	100	Corps of Engineers
Deep Creek	P	1925	68.5	13.1	-	-	93.0	106.1	-	-	Pennsylvania Elec. Co.
Lake Lynn	P	1926	1413	45.0	-	-	19.7	72.3	-	-	West Penn. Power Co.

---

[a] Project Purposes: F = Flood Control
P = Power
N = Navigation
L = Low Flow Augmentation - Principally for Quality Control
R = Recreation

[b] Storage Capacity Allocations:
Minimum - Storage provided for various purposes, which is not drawn down except in unusual circumstances.
Conservation - Storage which is fluctuated as required for low flow augmentation, quality control, water supply, recreation and other purposes.
Power - Storage above the minimum pool which is drawn down for the production of hydroelectric power.
Flood Control - Storage reserved exclusively for reduction of floods.
Total - Total storage in the reservoir under a flat pool at ungated spillway crest elevation, or maximum pool elevation with spillway gates closed.

[c] W = Winter
S = Summer

SOURCE: U.S. Army Corps of Engineers (10).

At the present time, the proposed Davis Lake Pumped Storage Project on the Blackwater River in the Canaan Valley of West Virginia is under review by the Corps of Engineers, the FPC, the Ohio River Basin Commission and other environmental agencies. The proposed impoundment would inundate an area considered by numerous groups and individuals to contain unique biota, particularly wetland species. The project would provide 1,000 MW capacity of pumped storage peaking power; it would impound 162,500 acre-feet of water at an elevation of 3,182 feet above mean sea level. The resulting 7,000 acre reservoir would also serve as a recreational lake (18).

B. The Allegheny River Basin

1. General Description

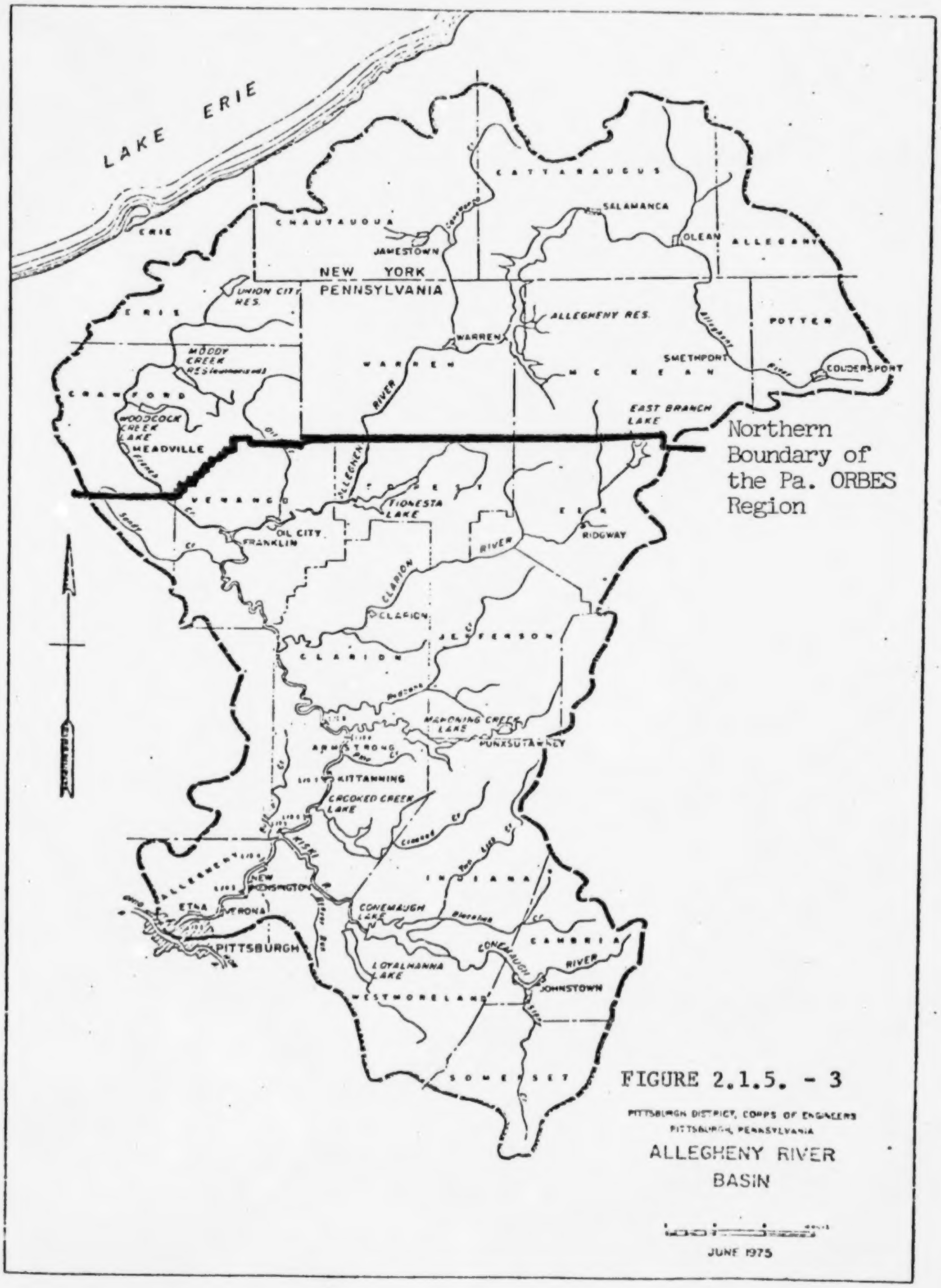
The Allegheny River originates outside of the ORBES Study Area in Potter County near Coudersport, Pennsylvania. The river flows northwestward from its source into New York State where it bends, forming a loop 50 miles long before re-entering Pennsylvania in Warren County. The river first enters the ORBES region in northwestern Forest County, from which it meanders in a southerly direction to its confluence with the Monongahela at Pittsburgh. Approximately 50% of the Allegheny's 325 mile length and 54% of its 11,778 square mile drainage basin lies within the ORBES Study Area. The hydrologic boundaries of the entire Allegheny River Basin are shown in Figure 2.1.5.-3.

2. Basin Configuration

The Allegheny River Basin is bordered by the Great Lakes - St. Lawrence River Basin to the north; by the Susquehanna River Basin to the east; by the Monongahela River Basin to the south; and by the Beaver River Basin along with a segment of the Ohio main stem drainage to the west. The maximum dimensions of the entire Allegheny Basin are approximately 175 miles in length (north-south axis) and 130 miles in width (east-west axis).

Figure 2.1.5-3

Map of Allegheny River Basin


LAKE ERIE
ERIE
CHAUTAUQUA
JAMESTOWN
CATTARAUGUS
SALAMANCA
OLEAN
ALLEGANY
NEW YORK
PENNSYLVANIA
UNION CITY RES.
ERIE
MOODY CREEK RES (authorized)
CRAWFORD
WOODCOCK CREEK LAKE
MEADVILLE
WARREN
ALLEGHENY RES.
WARREN
ALLEGHENY RIVER
POTTER
SMETHPORT
COUDERSPORT
M C K E A N
EAST BRANCH LAKE
VENANGO
FOREST
TIONESTA LAKE
OIL CITY
FRANKLIN
ELK
RIDGWAY
CLARION RIVER
CLARION
CLARION
JEFFERSON
MAHONING CREEK LAKE
PUNXSUTAWNEY
ARMSTRONG
KITTANNING
CROOKED CREEK LAKE
INDIANA
KISKI R.
NEW KENSINGTON
ETNA
VERONA
PITTSBURGH
CONEMAUGH LAKE
LOYALHANNA LAKE
CONEMAUGH RIVER
CAMBRIA
JOHNSTOWN
WESTMORELAND
SOMERSET
Northern Boundary of the Pa. ORBES Region
FIGURE 2.1.5. - 3
PITTSBURGH DISTRICT, CORPS OF ENGINEERS
PITTSBURGH, PENNSYLVANIA
ALLEGHENY RIVER BASIN
JUNE 1975

SOURCE: U.S. Army Corps of Engineers (9).

Nineteen counties in Pennsylvania and three in New York are contained partly or entirely within the Allegheny Basin (see Table 2.1.5.-5). The Pennsylvania portion of the watershed covers approximately 9,813 square miles, whereas only 1,965 square miles of the basin occur in New York.

3. Tributary Streams

Numerous tributaries of various sizes empty their waters into the Allegheny River along its course. However, only nine tributary streams exert major influences on the hydrology of the river. Most of these tributaries approach the Allegheny from the east where the topography is rugged. Table 2.1.5.-6 lists the physiographic characteristics of the Allegheny River and these major tributaries. The drainage areas and map coordinates of all streams within the Commonwealth of Pennsylvania are available in the "Pennsylvania Gazetter of Streams" (19). Detailed mapping of state streams is available in Higbee's "Stream Map of Pennsylvania" (20).

4. Basin Physiography

The Allegheny River Basin has portions of its drainage area in four different Sections of the Appalachian Plateaus Physiographic Province. All of Tionesta Creek, the upper Allegheny and Clarion Rivers, and lower Oil, French and Conewango Creeks are contained within the Allegheny High Plateaus Section, an unglaciated area characterized by highly dissected plateaus. Here, stream valleys are deep and have steep sides with only small tracts of flat land on some of the valley bottoms and stream divides.

Upper Oil Creek, as well as the majority of the French Creek Basin occurs within the Glaciated Section of the Appalachian Plateaus. This area consists of rounded hills with gentle slopes; valleys typically have broad and flat floodplains. Several natural lakes and swamps have been formed on the glacial deposits of this

---

*See Fig. 2.1.   of Geology Baseline

TABLE 2.1.5-5

COUNTIES OF THE ALLEGHENY RIVER BASIN

STATE	COUNTIES	PERCENT OF COUNTY LAND AREA IN BASIN
Pennsylvania	Allegheny	31.4
" "	Armstrong	100.0
" "	Butler	29.1
" "	Cambria	58.8
" "	Clarion	100.0
" "	Clearfield	9.9
" "	*Crawford	75.9
" "	Elk	67.2
" "	*Erie	49.2
" "	Forest	100.0
" "	Indiana	91.9
" "	Jefferson	100.0
" "	*McKean	97.4
" "	Mercer	15.8
" "	*Potter	28.6
" "	Somerset	37.7
" "	Venango	97.8
" "	Warren	100.0
" "	Westmoreland	58.0
New York	*Allegany	17.4
" "	*Cattaraugus	74.2
" "	*Chautauqua	71.6

*Not part of the ORBES Study Area

SOURCE: Fed. Wtr. Poll. Cntrl. Admin. (14)

TABLE 2.1.5. - 6

PHYSIOGRAPHIC CHARACTERISTICS OF MAJOR STREAMS OF THE ALLEGHENY RIVER BASIN

Stream	Miles above Mouth of Allegheny River	Drainage Area (sq.mi.)	Length of Stream (miles)	Slope (Feet per Mile)		
				Average	Headwater	Mouth
Allegheny River	0	11,700	325	2.7	33.2	0.9
Kiskiminetas River	30.2	1,890	27	3.4	-	-
Conemaugh River	-	1,370	52.2	6.0	-	-
Mahoning Creek	55.5	425	62.8	8.0	-	-
Redbank Creek	64.0	605	47.5	8.4	-	-
Clarion River	86.1	1,235	96.3	6.0	-	-
French Creek	126.6	1,235	108	6.5	-	-
Oil Creek	134.0	340	45	-	-	-
Tionesta Creek	154.2	480	58	13.1	-	-
Conewango Creek	192.0	900	71.5	4.0	-	-

SOURCE: U.S. Army Corps of Engineers (9).

region. This is largely because the post-glacial drainage has not yet had the time required to develop any significant degree of integration.

Blacklick Creek, most of the Conemaugh River, and the headwaters of Loyalhanna Creek lie in the Allegheny Mountains Section of the Appalachian Plateaus. This is an area of strong relief with a series of high ridges. The greatest local relief is approximately 1,600 feet at the Conemaugh River gap through Laurel Hill.

All of Mahoning Creek, Crooked Creek and the Kiskiminetas River flow through the Pittsburgh Plateaus Section of the Appalachian Plateaus. Most of the Allegheny main stem, the Clarion River, and Redbank Creek are also contained in this section. The hill summits of this section are in general conformity with the local relief. The maximum relief between the Allegheny River Valley and the highest hills is approximately 775 feet.

Basin-wide elevations range from over 2,500 feet above msl in the eastern section to 710 feet above msl at the Allegheny's mouth in Pittsburgh. The Allegheny main stem flows through a well-defined river valley with a floor width averaging 0.5 miles in the lower reaches.

5. Channel Characteristics

The lower 72 miles of the Allegheny main stem are managed for commercial navigation. The channel thalweg in this reach, under normal flow, ranges from 10-20 feet directly downstream of dams to 25-30 feet (or somewhat greater) (9). Channel widths (exclusive of islands) of the normal slackwater pools range from approximately 600 feet to 1,500 feet with an average of 1,000 feet. A more detailed description of the navigation pools can be found in Table 2.1.5.-7.

6. Impoundments

In the Allegheny Basin, a network of ten large reservoirs are operated by the Corps of Engineers chiefly as structural measures for flood control. These impoundments have a pronounced effect on the hydrology of the region as they con-

TABLE 2.1.5. - 7

CHARACTERISTICS OF THE ALLEGHENY RIVER NAVIGATION SYSTEM

Locks and Dams	River Mile	Dam Crest	Length of Pool (mile)	Upper Pool Elevation (ft. above msl)	Surface Area @ Normal Pool (Acres)	Storage @ Normal Pool (acre-feet)	Mean Pool Depth (feet)	Commenced Operation
Emsworth L/D (Allegheny Arm)	6.2[1]	Gated	6.7	710.0	725	10,000	13.8	Sept. 1921
L/D 2	6.7	Fixed	7.8	721.0	1120	14,500	12.9	Oct. 1934
L/D 3	14.5	Fixed	9.7	734.5	1220	16,800	13.8	Oct. 1934
L/D 4	24.2	Fixed	6.2*	745.0	710	9,000	12.7	Sept. 1927
L/D 5	30.4	Fixed	5.9	756.8	660	9,800	14.8	Oct. 1927
L/D 6	36.3	Fixed	9.4	769.0	1260	14,000	11.1	Oct. 1928
L/D 7	45.7	Fixed	6.9	782.1	640	8,400	13.1	Nov. 1930
L/D 8	52.6	Fixed	9.4	800.0	1010	15,200	15.0	May 1931
L/D 9	62.2	Fixed	11.8	822.0	1040	13,500	13.0	Oct. 1938

---

1. Ohio River Mileage for main channel dam

* Plus an additional 3.7 miles of slackwater on the Kiskiminetas River

SOURCE: U.S. Army Corps of Engineers (9).

trol the runoff from approximately 5,250 square miles of drainage area and provide a total storage capacity of about 2 million acre-feet. The allocated storage capacities for these reservoirs are as follows: 625,000 acre-feet for summer conservation, including low flow augmentation; 680,000 acre-feet for summer flood control; and 1.7 million acre-feet for winter flood control. Monthly releases of water from major reservoirs in the Allegheny Basin as well as the rest of Pennsylvania are published in the U.S. Geological Surveys "Water Resource Data for Pennsylvania" (21). These reservoirs are characterized in greater detail in Table 2.1.5.-8.

In addition to publically owned impoundments, several privately owned reservoirs associated with power generation are situated within the Allegheny Basin. The Pennsylvania Electric Company owns and operates the Piney Reservoir which drains 957 square miles above mile 13 of the Clarion River. Piney is operated for hydroelectric power generation (29 MW capacity) and has a maximum summer storage of approximately 28,900 acre-feet. The Keystone Station Dam impounds 830 acres of water on Crooked Creek and north Branch of Plum Creek in Armstrong County for use at the jointly owned, 1,640 MW coal-fired facility The Kinzua (Seneca) Pump Storage Reservoir is a 106 acre impoundment in Warren County yielding approximately 246 MW.

One large natural lake, Lake Chatauqua, drains 189 square miles of New York State. Although the capacity of this lake has not been determined, its surface area is approximately 21 square miles. Numerous man-made recreational lakes and several other natural lakes are also distributed throughout the basin. Among the more popular of these are Conneaut Lake, Lake Somerset, the Quemahoning Reservoir, Yellow Creek Lake, North Park Lake, the Bear Run Reservoir, Cuba Lake and Edinboro Lake. Descriptive material on most of the impoundments in the Commonwealth of Pennsylvania as of 1970 is available in "Dams, Reservoirs, and Natural Lakes." (16).

Several potential sites for Corps of Engineers' reservoirs have been identi-

TABLE 2.1.5. - 8

MAJOR FLOOD CONTROL AND MULTI-PURPOSE RESERVOIRS IN THE ALLEGHENY RIVER BASIN[a]

RESERVOIR	LOCATION PA. COUNTY	PURPOSE[b]	DATE IN OPERATION	DRAINAGE AREA SQ. MI.	STORAGE CAPACITY (1000 ac. ft)[c]				MINIMUM RELEASE (cfs)	
					MINIMUM	CONSERVATION	FLOOD CONTROL[d]	TOTAL	WINTER	SUMMER
Allegheny (Kinzua Dam)	Warren	FLRP	1967	2,180	24	216.0W 549.0S	940.0W 607.1S	1,180.0	500	500
Conemaugh	Indiana	FR	1953	1,351	4.0		270.0	274.0	100	100
Crooked Cr.	Armstrong	FR	1940	277	4.5		89.4	93.9	5	5
East Br. Clarion	Elk	FLR	1952	72.4	1.0	44.6W 64.3S	38.7W 19.0S	84.3	20	20
Loyalhanna	Westmoreland	FR	1942	290	2.0		93.3	95.3	10	10
Mahoning Cr.	Armstrong	FR	1941	340	4.5		69.7	74.2	10	10
Tionesta	Forest	FR	1940	473	7.8		125.6	133.4	5	5
Union City	Erie	FR	1970	222	0	1.4W 8.4S	46.3W 39.3S	47.7	-	-
Woodcock Cr.	Crawford	FRL	1974	45.7	0.9	0.4W 4.0S	18.7W 15.1S	20.0	5	5

---

a. All owned and operated by Corps of Engineers

b. Purposes: F = Flood Control, P = Power
L = Low Flow Augmentation - Principally for Quality Control
R = Recreation

SOURCE: U.S. Army Corps of Engineers (9)

c. Storage Capacity Allocations:
Minimum - Storage provided for various purposes, which is not drawn down except in unusual circumstances
Conservation - Storage which is fluctuated as required for low flow augmentation, quality control, water supply, recreation and other purposes.
Flood Control- Storage reserved exclusively for reduction of floods
Total - Total storage in the reservoir under a flat pool at ungated spillway crest elevation, or maximum pool elevation, or maximum pool elevation with spillway gates closed.

d. W = Winter, S = Summer

fied in the Allegheny River Basin. The St. Petersburg Reservoir on the Clarion River is one of the most significant of these proposed projects. A storage volume of 800 thousand acre-feet is the planned capacity at full pool.

C. The Upper Ohio River Sub-basin (Pa.)

1. General Description

The Ohio River is formed by the confluence of the Allegheny and Monongahela Rivers at Pittsburgh, Pennsylvania. At "The Point" in Pittsburgh, the Allegheny and Monongahela account for 61.5% and 38.5% respectively of the Ohio River's 19,164 square mile headwater drainage area. The Ohio flows southwesterly for 981 miles to Cairo, Illinois where its drainage area (exclusive of the Tennessee River Basin) covers approximately 163,000 square miles. The Ohio Basin in bordered on the north by the Great Lakes drainage area, on the east by the Appalachian divide, on the south by the Tennessee Valley, and on the west by the Mississippi River.

2. Sub-basin Configuration

The portion of the Ohio River Basin within the Commonwealth of Pennsylvania and exclusive of the Allegheny and Monongahela Basins is known as Pa. DER* Sub-basin #20. This sub-basin is triangular in shape with a drainage area of 3,080 square miles. The base of the "triangle" corresponds to the state boundary line; it is approximately 139 miles in length (north-south), extending from Pymatuning Reservoir to Ryerson Station State Park. The legs of the sub-basin "triangle" average about 78 miles in length from Pymatuning and Ryerson State Park to Butler, Pa. (see Figure 2.1.5.-4)

Geopolitically, Sub-basin #20 contains all of Beaver and Lawrence Counties, most of Mercer County, two-thirds of Butler County, approximately half of Allegheny and Washington Counties, and small sections of Crawford, Greene and Venango Counties. (see Table 2.1.5.-9).

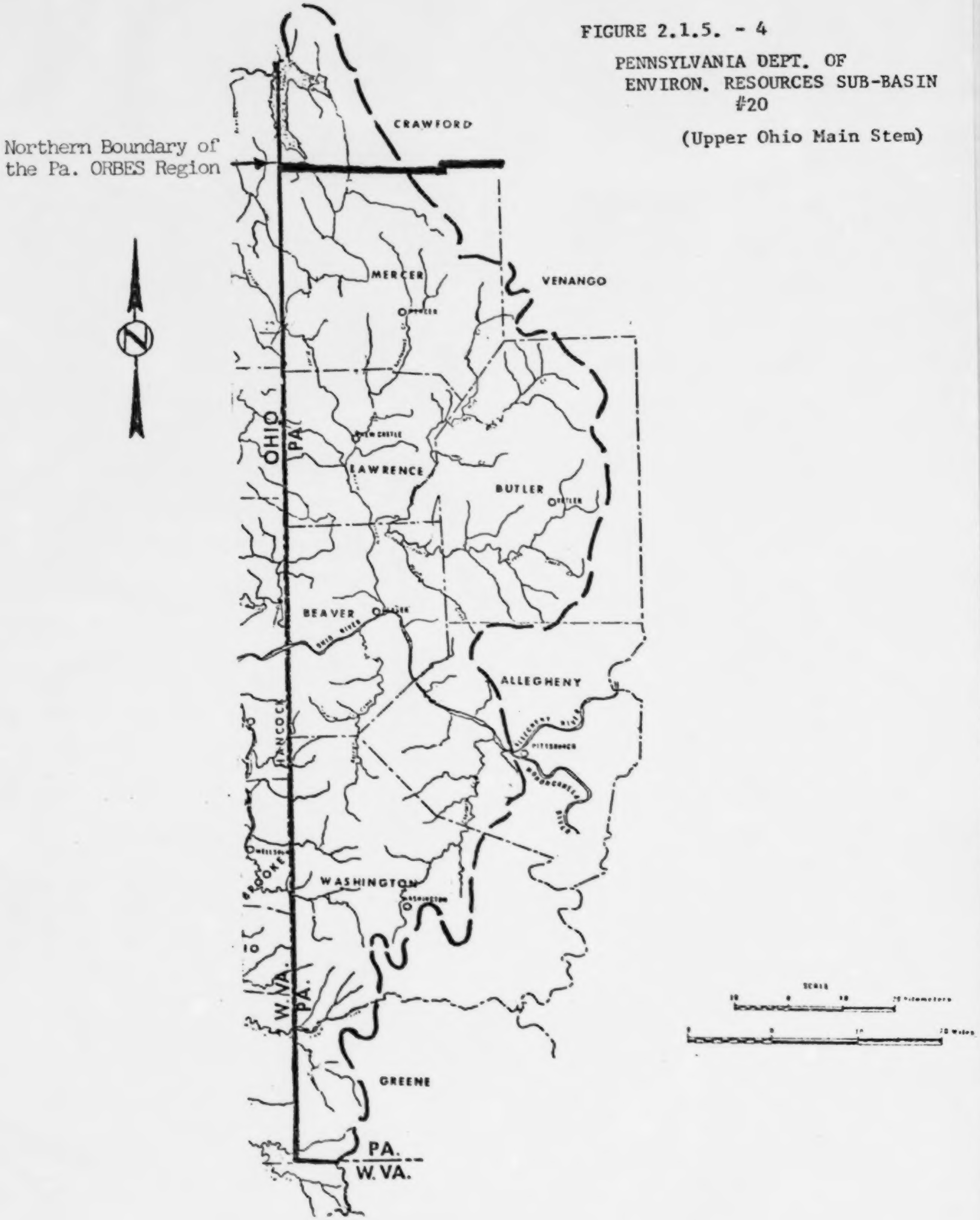
---

*Pennsylvania Department of Environmental Resources

FIGURE 2.1.5. - 4

PENNSYLVANIA DEPT. OF
ENVIRON. RESOURCES SUB-BASIN
#20

(Upper Ohio Main Stem)


Northern Boundary of
the Pa. ORBES Region
N
CRAWFORD
MERCER
VENANGO
NEW CASTLE
LAWRENCE
BUTLER
OHIO
PA.
BEAVER
OHIO RIVER
ALLEGHENY
ALLEGHENY RIVER
PITTSBURGH
MONONGAHELA RIVER
HANCOCK
BROOKE
WASHINGTON
W. VA.
PA.
GREENE
PA.
W. VA.
SCALE

SOURCE: Adapted from Ohio River Basin Commission (22).

TABLE 2.1.5. - 9

COUNTIES OF PA. DER
SUB-BASIN #20
(Upper Ohio - Beaver Basins within Pennsylvania)

State	County	Percent of County Land Area in Basin
Pennsylvania	Allegheny	37.9
" "	Beaver	100.0
" "	Butler	70.9
" "	*Crawford	15.0
" "	Greene	21.3
" "	Lawrence	100.0
" "	Mercer	84.2
" "	Venango	2.2
" "	Washington	63.2

SOURCE: Fed. Wtr. Poll. Cntrl. Admin. (14)

3. Tributary Streams

Forty miles of the Ohio River extend from Pittsburgh to the Pennsylvania State line. Along this reach of the river, 41 tributary streams enter the main stem. The hydrology of the region, however, is chiefly governed by only three of these tributaries - the Beaver River, Chartiers Creek and Raccoon Creek. These three streams collectively drain approximately 73% of the land area in Sub-basin #20.

The Beaver River is the largest and hydrologically most significant tributary of the Ohio River in Pennsylvania. The Beaver is formed by the confluence of the Mahoning and Shenango Rivers near New Castle, Pa. from which it flows in a southernly direction for 21 miles before joining the Ohio at Rochester, Pa. (Ohio River mile 25.4). The Beaver drains 1,368 square miles of northeastern Ohio and 1,785 square miles of northwestern Pennsylvania. The river's slope ranges from 1.6 feet per mile at its headwaters to 11.3 feet per mile near its mouth. The average slope for the entirety of the river is approximately 4.1 feet per mile (23).

4. Sub-basin Physiography

The northern third of Sub-basin #20 lies within the Glaciated Section of the Appalachian Plateaus. Rounded hills and rolling terrain dominate the landscape in this region. Most of the major waterways have broad, flat floodplains which may contain as much as 400 feet of unconsolidated glacial outwash deposits (24). Drainage patterns are generally not fully developed or integrated; consequently, wetlands are more common in this area than in the rest of the Pennsylvania ORBES region. In the past, glaciation overdeepened numerous valleys in this section, which are today occupied by small, slowly flowing streams. Crude radial and trellis drainage patterns are common in this section.

The hilly terrain of the Pittsburgh Plateaus Section contains the southern two-thirds of Sub-basin #20. In this region, stream valleys have cut into the upland surface and the drainage system is characterized as being well-developed and of a dendritic pattern. In Washington County, hilltops average 1,300 feet above mean sea level (msl) with valley floors at 1,000 feet above msl.

5. Channel Characteristics

Three locks and dams are located in the Pennsylvania reach of the Ohio River. A fourth structure, the New Cumberland Locks and Dam is situated in West Virginia but has 8.3 miles of its pool within Pennsylvania. The navigation pools of the Upper Ohio are characterized in Table 2.1.5.-10. The river is dredged to provide a minimum navigable channel depth of 9 feet. The mid-channel depth in actuality, however, ranges between 20 and 35 feet. The channel widths (exclusive of islands) of the first four pools range from 1,340 - 1,400 feet. The average slope and thalweg slope of the river in this reach are 0.9 feet per mile and 1.5 feet per mile, respectively (23, 26). The average slope for the entire 981 miles of the Ohio is approximately 0.4 feet per mile.

6. Impoundments

The upper Beaver River Basin contains seven large reservoirs, most of which lie outside Sub-basin #20 in northeastern Ohio. These impoundments collectively drain 1,524 square miles and have a total usable storage capacity of approximately 713,000 acre-feet. Table 2.1.5.-11 characterizes the individual reservoirs in greater detail. Sub-basin #20 does not contain any natural lakes but approximately one hundred water supply and recreational impoundments exist throughout the area. Lake Arthur is the largest state-owned, man-made lake that is contained entirely within the state; it impounds approximately 37,000 acre-feet of water on Muddy Creek in Butler County.

2.1.5.3. STREAM FLOW

A. General Conditions

1. The Monongahela Basin

The four impoundments of the Monongahela Basin have a pronounced effect on the hydrology of the region. The storage of water in the Tygart and Youghiogheny reservoirs during peak runoff periods serves to reduce the frequency of flooding. Deep Creek Lake and Lake Lynn, although not operated to provide flood control,

TABLE 2.1.5. - 10

CHARACTERISTICS OF THE UPPER OHIO RIVER NAVIGATION SYSTEM

Locks and Dams	River Mile	State	Dam Crest	Length of Pool (mile)	Upper Pool Elevation (ft. above msl)	Surface Area @ Normal Pool (Acres)	Storage @ Normal Pool (acre-feet)	Mean Pool Depth (feet)	Commenced Operation
Emsworth	6.2[1]	PA	Gated	6.2	710.0	1,220	18,900	15.5	Sept. 1921[2]
Dashields	13.3	PA	Fixed	7.1	692.0	1,200	17,000	14.2	Aug. 1929
Montgomery	31.7	PA	Gated	18.4*	682.0	2,990	57,500	19.2	June 1936
New Cumberland	54.4	WVa.	Gated	22.7	664.5	3,840	74,000	19.3	Oct. 1959

1. Mileage for main channel dam
2. Original Construction

* Plus 2.6 miles of slackwater on the Beaver River

SOURCE: U.S. Army Corps of Engineers (25)

TABLE 2.1.5. - 11

MAJOR RESERVOIRS OF THE BEAVER RIVER BASIN

RESERVOIR	LOCATION COUNTY, STATE	PURPOSE	DATE IN OPERATION	DRAINAGE AREA SQ. MI.	PERM MIN POOL AREA (ACRES)	STORAGE (ACRE-FEET)			OPERATOR
						MAX. FLOOD CONTROL	WATER SUPPLY	MAXIMUM SUMMER	
Berlin	Portage, OH	FLW	1942	248	240	55,800	19,400	39,000	Corps. of Engineers
Milton	Mahoning, OH	L	1916	273	1,685			21,600	City of Youngstown, OH
Mosquito Cr.	Trumbull, OH	FLW	1943	97.5	700	33,000	11,000	71,400	Corps of Engineers
Meander Cr.	Trumbull, OH	W	1929	83.9	2,010		30,675		Mahoning Valley Sanitary Dis
Michael J. Kirwan	Portage, OH	FL	1966	80.5	580	33,200		56,700	Corps of Engineers
Pymatuning Lk.	Crawford, PA	FLR	1934	158	14,650	194,000		160,000	Pa. Dept. Environ. Resources
Shenango	Mercer, PA	FLR	1967	583	1,910	180,900		41,400	Corps of Engineers

F - Flood Control
L - Low Flow Augmentation
W - Water Supply
R - Recreation

SOURCES: Fed. Wtr. Poll. Cntrl. Admin. (14) and
U.S. Geologic Surv. (21).

do indeed provide this service on chance occasions.

The release of water from the Corps of Engineers' Reservoirs during low flow periods augments downstream flows. Tygart River Lake is operated to provide a minimum flow of 340 cfs in the Upper Monongahela whereas the release schedule for the Youghiogheny River Lake is designed to provide a minimum flow of 200 cfs in the Youghiogheny River at Connellsville.

During periods of peak power demand, hydroelectric plants must release large volumes of water. Discharges from the Piney Reservoir in the Allegheny Basin and Deep Creek Lake in the Monongahela Basin can cause substantial flow variation in the Clarion and Upper Youghiogheny Rivers. Hydroelectric power-induced flow variation is perhaps best exemplified by the effects of Lake Lynn discharges when low flows occur in the Monongahela River above its confluence with the Cheat River. During such episodes, abrupt translatory waves are created in the Monongahela by Lake Lynn discharges and flows fluctuate widely by the hour (15).

Since almost two-thirds of the Monongahela Basin is located outside of Pennsylvania, the flow characteristics of the lower Monongahela are determined to a large degree by the hydrologic characteristics of northern West Virginia and to a lesser degree, Garrett County, Maryland. Indeed, a mere 30% of the Monongahela River flow at the mouth (Pittsburgh) originates from within Pennsylvania (27). Stream flow characteristics for the Monongahela Basin, determined at USGS gaging stations for the period of record prior to and including water year 1976, are presented in Table 2.1.5.-12. Table 2.1.5.-13 depicts flow-duration characteristics as determined for specified years at many of the USGS stations.

It is readily apparent from the aforementioned tables that, despite existing navigation and flood-control projects, the Monongahela and Youghiogheny are capable of wide flow variations. However, the seasonal flow variation of the smaller, uncontrolled tributaries is even more dramatic. Many of these tributaries are swollen, turbulent white-waters in the spring and mere trickles during the late

TABLE 2.1.5. - 12

HYDROLOGIC CHARACTERISTICS OF

MONONGAHELA BASIN STREAMS

USGS STATION NUMBER	STREAM	LOCATION*	DRAINAGE AREA @ GAGE (SQ.MI.)	PERIOD OF RECORD	AVERAGE ** DISCHARGE(cfs)	INSTANTANEOUS MAXIMUM (cfs) AND DATE (mo/yr)	MINIMUM DAILY (cfs) AND DATE (mo/yr)	INSTANTANEOUS MINIMUM (cfs) AND DATE (mo/yr)	AVERAGE ANNUAL RUNOFF (in.)
630	Monongahela R.	Point Marion	2,720	1939-55	4,494	90,400-3/36	235-2/40	---	---
720	Dunkard Cr.	Shannopin	229	1910-76	272	16,800-6/41	---	0.4-8/44	16.13
725	Monongahela R.	Greensboro	4,407	1938-76	8,089	134,000-3/67	204-9/46	---	24.93
725.9	Georges Cr.	Smithfield	16.3	1963-76	19.2	1,640-6/72	---	0-8/65,9/66	16.00
728.4	Tenmile Cr.	Clarksville	133	1968-76	149	20,200-9/75	---	1.4-9/73	15.21
730	South Fork Tenmile Cr.	Jefferson	180	1931-76	199	13,800-6/41	---	0.05-9/38	15.01
745	Redstone Cr.	Waltersburg	73.7	1942-76	98.5	8,660-6/72	---	4.2-8/62	18.15
750	Monongahela R.	Charleroi	5,213	1933-76	8,975	158,000-3/67	---	---	23.38
755	Youghiogheny R.	Oakland, Md.	134	1942-76	291	11,800-10/54	2.5-10/53	---	29.49
765	Youghiogheny R.	Friendsville, Md.	295	1899-1904 1941-76	637	13,000-10/54	8.2-9/66	---	29.32
775	Youghiogheny R.	Below dam	436	1939-76	859	13,700-5/48	---	~0-5,6/50[1]	26.76
780	Casselman R.	Grantsville, Md.	62.5	1948-76	117	8,400-10/54	---	0-8/62	25.42
790	Casselman R.	Markleton	382	1920-76	652	50,000-10/54	---	10-9/57	23.18
800	Laurel Hill Cr.	Ursina	121	1918-76	266	10,900-10/54	---	2.2-9/32	29.85
810	Youghiogheny R.	Confluence	1,029	1941-76	1,965	69,500-10/54	121-9/43	40-10/43	25.93
825	Youghiogheny R.	Connellsville	1,326	1909-76	2,548	103,000-10/54	---	11-9/08;10/10	26.09
835	Youghiogheny R.	Sutersville	1,715	1920-76	2,995	108,000-10/54	---	57-9/22	23.72
845	Turtle Cr.	Trafford	121	1920-52	76.8	5,200-5/46	---	0.1-10/22;9/39	---
850	Monongahela R.	Braddock	7,337	1938-76	12,300	201,000-6/41	703-9/45	559-9/46	22.77

* Pennsylvania locations unless otherwise noted
** Monongahela and Youghiogheny flows adjusted for storage
1. Reservoir gates closed

SOURCE: Adapted from U.S. Geol. Survey (21).

T A B L E 2.1.5. - 13

FLOW DURATION CHARACTERISTICS
OF THE STREAMS IN THE
MONONGAHELA RIVER BASIN

STREAM	STATION	YEARS OF RECORD USED	Discharge in cubic feet per second which was equaled or exceeded for indicated percentage of time.												
			2	5	10	20	30	40	50	60	70	80	90	95	98
Monongahela R.	L/D8, Point Marion	1929 -54	21,000	15,000	11,000	7,300	5,000	3,500	2,400	1,700	1,200	780	570	470	380
Monongahela R.	Greensboro	1940 - 60	35,000	26,000	20,000	13,000	9,200	6,600	4,600	3,300	2,300	1,500	900	640	480
Monongahela R.	Charleroi	1934 - 60	42,000	29,000	22,000	14,000	9,900	7,000	4,900	3,600	2,500	1,700	1,000	740	550
Monongahela R.	Braddock	1940 - 60	52,000	38,000	29,000	20,000	14,000	10,600	7,600	5,800	4,100	2,900	2,000	1,600	1,200
Youghiogheny R.	Dam	1939 - 60	3,500	2,400	1,700	1,200	890	730	630	540	450	330	220	160	120
Youghiogheny R.	below Confluence	1941 - 60	7,700	5,700	4,300	2,800	2,100	1,600	1,200	1,000	850	680	500	350	250
Youghiogheny R.	Connellsville	1910 - 60	12,000	8,000	5,700	3,800	2,700	2,000	1,500	1,200	850	590	350	220	130
Youghiogheny R.	Sutersville	1921 - 60	13,000	9,000	6,700	4,400	3,200	2,500	1,800	1,400	1,100	800	510	380	260
Casselman R.	Markleton	1921 - 60	3,600	2,300	1,500	940	660	470	330	230	150	94	50	32	21
Laurel Hill Creek	Ursina	1919 - 63	1,400	920	630	390	280	200	140	100	68	42	22	14	8.8
Dunkard Creek	Shannopin	1942 - 60	2,100	1,200	680	360	230	150	96	56	31	15	5.6	2.9	1.8
South Fork Tenmile	Jefferson	1932 - 60	1,500	830	480	260	160	100	64	35	19	8.3	2.5	1.2	0.7
Redstone Creek	Waltersburg	1943 - 60	480	300	210	140	110	82	62	47	35	28	23	19	16
Turtle Creek	Trafford	1920 - 52	510	300	180	100	70	48	32	21	13	7.4	3.8	2.3	1.3

SOURCE: Adapted from Busch and Shaw (28).

summer and early fall.

In terms of velocity, the Monongahela main channel maximum (100-year flood) is approximately 11 feet per second. Although published averages of velocity for the 7 day, 10-year low flow do not exist, they are estimated at 0.3 feet per second (10).

Approximately 25% of the Monongahela's mean discharge at Pittsburgh (12,500 cfs) originates from within the Youghiogheny Basin (29). This percentage becomes substantially greater during periods of low flow in the Monongahela main stem (15). At base flow, the Monongahela River is naturally a low-yielding stream. Youghiogheny River water is generally of better quality than that of the Monongahela. Consequently, flow contributions from the Youghiogheny tend to ameliorate the downstream-trend of water quality deterioration in the Monongahela.

Runoff from approximately 94% of the Upper Monongahela Basin (West Virginia and Maryland) enters ORBES Pennsylvania via the Monongahela main stem, the Cheat River, and the Youghiogheny River Lake (27). The average annual runoff within Sub-basin #19 varies from 14 inches in the west to 28 inches in the east with an area mean of about 19 inches. However, the mean annual runoff for the entire Monongahela Basin is 22.5 inches. Table 2.1.5.-12 includes annual runoff figures for specific sites (USGS gaging stations) in the Monongahela Basin.

2. The Allegheny Basin

The nine Corps of Engineers' reservoirs and to a lesser extent, the Piney Reservoir influence the hydrology of the basin by reducing flood flows by storage of water during periods of heavy rainfall and/or intense snowmelt. The Allegheny, Woodcock Creek, and East Branch Reservoirs are also operated to provide low flow augmentation by the release of stored water during periods of minimal surface runoff. The basin reservoirs (excepting the Allegheny Reservoir*), when considered individually, have little influence on the flow of the lower Allegheny River (9).

---

*The Allegheny Reservoir has large storage capacities for flood control and low flow augmentation.

Consequently, the Corps manages its facilities as an integrated system, thereby obtaining a substantial cumulative effect upon flows in the Allegheny main stem. Nonetheless, several individual reservoirs do indeed regulate flow appreciably in some of the Allegheny's tributaries.

The flow of the Allegheny main stem is determined largely by the hydrologic characteristics of the northern portion of the basin, including the effects of the Allegheny Reservoir. However, 12% of the average discharge at Pittsburgh originates within the Kiskiminetas watershed (29). This flow contribution is significant since acid mine drainage originating in the Kiskiminetas Basin has a detrimental effect on water quality and aquatic ecology in the lower Allegheny.

Decreases in stream gradient and changes in channel conformation hydraulically serve to reduce stream velocity in the lower reach of a river. The navigation dams in the lower Allegheny intensify this phenomenon. Under major flood conditions (100-year flood), the maximum velocity in the slackwater pools is approximately 8-9 feet per second, whereas the maximum velocity of the upper Allegheny is almost 15 feet per second (9). Under low flow conditions (7-day, 10-year low flow), the maximum velocity of the Allegheny in New York is approximately 7.8 miles per day (23). Low flow velocities for the lower Allegheny are estimated to be on the order of 5 miles per day or lower (9).

The hydrologic characteristics of streams in the Allegheny Basin as determined at USGS gaging stations are presented in Table 2.1.5.-14. Table 2.1.5.-15 depicts the flow-duration characteristics of selected basin waterways at many of these same USGS stations; changes in flow-duration are included for several stations before and after the construction of east Branch, Piney, and Crooked Creek Reservoirs. Table 2.1.5.-16 characterizes the flow-duration of the Allegheny main stem at the Natrona gage (river mile 24.3).

Average annual runoff within the Allegheny Basin ranges from approximately 18

TABLE 2.1.5. - 14

HYDROLOGIC CHARACTERISTICS OF ALLEGHENY RIVER BASIN STREAMS

USGS STATION NUMBER	STREAM	LOCATION	DRAINAGE AREA @ GAGE (sq. mi.)	PERIOD OF RECORD (wtr. yr.)	AVERAGE[1] DISCHARGE(cfs)	INSTANTANEOUS MAXIMUM (cfs) AND DATE (mo/yr)	MINIMUM DAILY (cfs) AND DATE (mo/yr)	INSTANTANEOUS MINIMUM (cfs) AND DATE (mo/yr)	AVERAGE ANNUAL RUNOFF (in)
0105.	Allegheny R.	Eldred	550	1939-76	941	65,400-6/72	---	22-9/59	23.23
0110.2	Allegheny R.	Salamanca, NY	1,608	1903-76	2,777	73,000-6/72	79-9/71	---	23.45
0118	Kinzua Cr.	Guffey	46.4	1965-76	76.8	5,220-6/72	---	4.0-9/66	22.48
0125.5	Allegheny R.	Below Dam	2,180	1935-76	3,803	60,500-3/56	---	---	23.69
0150	Conewango Cr.	Russell	816	1939-76	1,475	14,400-4/47	57-10/60	---	24.54
0152.8	Jackson Run	North Warren	12.8	1962-76	23.4	1,020-3/72	---	0.4-10/63	24.87
0155	Brokenstraw Cr.	Youngsville	321	1909-76	579	18,000-3/13	---	19-10/34	24.50
0160	Allegheny R.	West Hickory	3,660	1941-76	6,519	101,000-3/56	---	---	24.19
0175	Tionesta Cr.	Lynch	233	1937-76	457	15,000-1/59	---	11-8/62	24.94
0200	Tionesta Cr.	Below Dam	479	1941-76	869	13,500-3/64	0.4-2,5,6/68	---	24.64
0205	Oil Cr.	Rouseville	300	1933-76	526	21,000-1/59	---	22-7,9/34	23.81
0215.2	French Cr.	Union City	220	1909-76	422	20,000-4/47	---	3.9-8/30	26.05
0240	French Cr.	Utica	1,028	1933-76	1,770	23,800-3/64	---	43-7/34	23.38
0250	Sugar Cr.	Sugarcreek	166	1933-76	270	10,000-5/46	---	9.2-10/35	22.09
0252	Patchel Run	Franklin	5.69	1965-76	8.91	1,650-7/72	---	0.42-10/66	21.26
0255	Allegheny R.	Franklin	5,982	1914-76	10,370	138,000-3/20	---	334-7/34	23.54
0275	East Br. Clarion R.	Below Dam	73.2	1948-76	133	2,590-5/57	0.40-7/69	0.20-7/69	25.04
0280	West Br. Clarion R.	Wilcox	63.0	1953-76	122	5,490-9/67	---	4.2-9/55	26.30
0285	Clarion R.	Johnsonburg	204	1945-76	377	11,700-5/46	20-10/48	6-9/52	25.10
0294	Toms Run	Cooksburg	12.6	1959-76	19.1	656-3/64	0.31-8/71	---	20.59
0295	Clarion R.	Cooksburg	807	1938-76	1,434	53,300-6/72	---	41-8/39	24.13
0305	Clarion R.	Piney	951	1944-76	1,745	74,500-6/72	---	---	24.92
0315	Allegheny R.	Parker	7,671	1932-76	13,220	175,000-1/59	---	409-7/34	23.43
0325	Redbank Cr.	St. Charles	528	1918-76	856	50,000-3/36	---	19-10/18	22.02
0340	Mahoning Cr.	Punxsutawney	158	1938-76	273	17,300-6/72	---	2.6-9/39	23.46
0345	Little Mahoning Cr.	McCormick	87.4	1939-76	150	6,200-6/72	---	0.3-9/59	23.31
0360	Mahoning Cr.	Below Dam	344	1939-76	589	10,400-3/42	---	8.8-9/59	23.25
0365	Allegheny R.	Kittanning	8,973	1905-28, 1934-76	15,570	269,000-3/13	---	570-9/13	23.56
0380	Crooked Cr.	Idaho	191	1937-76	287	13,200-6/72	1.0*-10/66	---	20.41
0390	Crooked Cr.	Below Dam	278	1909-76	421	21,000-3/36	---	0.1-9/32	20.57
0400	Stony Cr.	Ferndale	451	1938-76	765	59,000-3/36	---	5-9/29	23.03
0410	Little Conemaugh R.	East Conemaugh	183	1940-76	322	16,600-6/72	---	3.4-9,10/63	23.90
0415	Conemaugh R.	Seward	715	1939-76	1,265	54,000-10/54	105-12/38	---	24.03
0420	Blacklick Cr.	Josephine	192	1952-76	360	20,800-6/72	---	19-9/52,11/53	25.46
0422.8	Yellow Cr.	Homer City	57.4	1967-76	107	4,100-6/72	---	1.4-7/69	25.32
0425	Two Lick Cr.	Graceton	171	1952-76	276	19,600-6/72	8.7-9/52	2.0-9/52	21.92
0440	Conemaugh R.	Tunnelton	1,358	1939-76	2,349	59,200-3/45	1-9/54	1-9/54	23.49
0450	Loyalhanna Cr.	Kingston	172	1939-76	301	29,700-10/54	0.2-10/53	0.1-9/53	23.76
0470	Loyalhanna Cr.	Below Dam	292	1939-76	480	11,700-6/41	0.2-10/47	0.2-10/47,9/48	22.32
0485	Kiskiminetas R.	Vandergrift	1,825	1938-76	3,058	71,900-3/40	60-10/52	56-10/52	22.75
0490	Buffalo Cr.	Freeport	137	1940-76	190	14,000-10/54	---	1.3-10/60	18.83
0495	Allegheny R.	Natrona	11,410	1938-76	19,240	238,000-12/42	---	895-10/63	22.90

* Result of Abnormal Regulation

1. Stations downstream of impoundments regulated for storage

SOURCE: Adapted from U.S. Geol. Survey (21).

TABLE 2.1.5.-15

FLOW DURATION CHARACTERISTICS OF THE STREAMS IN THE ALLEGHENY RIVER BASIN

			Discharge in cubic feet per second which was equaled or exceeded for indicated percentage of time.												
STREAM	STATION	YEARS OF RECORD USED	2	5	10	20	30	40	50	60	70	80	90	95	98
Tionesta Cr.	Below Dam	1941-60	4,900	3,300	2,300	1,400	930	710	440	240	200	120	76	58	42
Oil Cr.	Rouseville	1933-60	3,000	1,900	1,200	740	510	360	270	190	140	90	54	44	36
French Cr.	Utica	1933-60	8,800	6,200	4,400	2,800	1,900	1,300	910	620	410	240	140	110	84
Sugar Cr.	Sugarcreek	1933-60	1,500	950	610	380	270	190	140	100	72	48	32	25	21
Allegheny R.	Franklin	1931-63	49,000	35,000	26,000	16,000	11,000	7,900	5,400	3,800	2,600	1,600	1,000	770	640
E. Br. Clarion	Below Dam	1949-52	720	490	360	240	180	130	90	56	29	18	12	9.5	8.0
		1953-60	500	290	240	210	170	130	83	45	28	22	18	16	14
W. Br. Clarion	Wilcox	1954-60	610	400	280	180	130	96	77	57	41	25	14	10	6.4
Clarion R.	Johnsonburg	1946-52	2,100	1,400	980	630	470	340	220	160	95	57	35	29	26
		1953-60	1,600	1,000	720	470	380	310	250	230	200	160	100	45	32
Clarion R.	Ridgway	1941-53	3,000	2,000	1,400	900	620	440	310	230	160	92	54	42	35
Clarion R.	Cooksburg	1939-52	7,500	4,900	3,500	2,300	1,600	1,100	800	540	360	220	130	100	78
		1953-60	6,100	4,200	3,100	2,100	1,600	1,200	920	690	520	380	270	150	97
Clarion R.	Piney	1949-52	9,600	6,800	4,900	3,200	2,300	1,600	1,100	680	350	170	64	30	26
		1953-60	7,500	5,300	3,900	2,600	1,900	1,400	1,100	800	560	370	130	27	24
Clarion R.	St. Petersburg	1942-53	11,000	7,500	5,500	3,600	2,600	1,800	1,200	840	540	330	170	97	66
Redbank Cr.	St. Charles	1919,1922-57	4,600	3,100	2,100	1,300	840	580	400	270	180	110	72	53	41
Mahoning Cr.	Punxsutawney	1939-60	1,400	910	620	400	280	200	140	100	68	44	29	24	20
Little Mahoning	McCormick	1940-60	900	560	360	220	150	100	70	47	30	15	6.6	3.9	2.4
Mahoning Cr.	Below Dam	1939-60	3,100	2,000	1,500	890	600	420	290	200	140	85	46	31	22
Crooked Cr.	Idaho	1938-60	1,800	1,100	710	410	270	190	130	84	53	31	16	11	7.7
Crooked Cr.	Below Dam	1919-40	2,800	1,600	1,000	530	340	230	150	94	58	33	17	9.0	4.3
		1941-60	2,600	1,700	1,100	720	440	260	190	120	76	44	24	17	12
Stony Cr.	Ferndale	1914-35,40-60	3,700	2,400	1,600	970	650	450	310	220	150	94	50	31	21
Little Conemaugh R.	East Conemaugh	1940-60	1,500	930	640	420	290	200	140	96	66	42	20	13	8.8
Conemaugh R.	Seward	1939-60	5,900	4,000	2,800	1,800	1,300	920	670	530	420	330	250	210	190
Blacklick Cr.	Josephine	1953-60	1,800	1,100	850	540	370	260	180	130	95	68	43	34	29
Two Lick Cr.	Graceton	1951-60	1,500	960	650	400	280	200	140	90	59	38	22	17	14
Blacklick Cr.	Blacklick	1905,08-51	3,800	2,400	1,600	990	660	470	340	240	160	100	62	44	31
Loyalhanna Cr.	Kingston	1941-60	1,600	1,000	750	440	310	220	160	110	72	41	19	10	3.5
Kiskiminetas R.	Vandergrift	1938-60	14,000	10,000	7,200	4,700	3,300	2,400	1,700	1,300	900	650	440	360	290
Buffalo Cr.	Freeport	1941-60	1,200	730	470	280	190	130	90	59	35	19	9.2	6.6	4.9

SOURCE: Adapted from Rusch and Shaw (28).

TABLE 2.1.5. - 16

FLOW - DURATION CHARACTERISTICS[a] OF THE ALLEGHENY RIVER AT NATRONA, PA.[b]

Discharge (cfs)	Percent of Time Flow Equaled or Exceeded
1,000	100.0
2,000	100.0
3,000	99.0
4,000	85.8
5,000	75.9
6,000	66.2
7,000	60.8
8,000	56.5
9,000	53.1
10,000	50.0
11,000	47.1
12,000	44.7
13,000	42.6
14,000	40.6
15,000	38.7
16,000	37.0
17,000	35.5
18,000	34.0
19,000	32.6
20,000	31.3

---

[a] For present conditions of development (April 1975)

[b] River Mile 24.3

SOURCE: U.S. Army Corps of Engineers (9).

inches in areas near Pittsburgh to sites yielding 26 inches at French Creek and the West Branch of the Clarion River (21,30). Table 2.1.5.-14 includes annual runoff figures for USGS stations within the basin. Runoff is more or less homogeneous in the upper portion of the basin; however, runoff tends to decrease from east to west in the middle and lower sections; reflecting changes in the distribution of precipitation (30, 31, 32).

3. The Upper Ohio Basin (Pa.)

Approximately 60% of the Ohio River's mean discharge at Pittsburgh is contributed by the Allegheny River, the remaining 40% is contributed by the Monongahela (29). The flow of the Ohio for its first 25 miles is chiefly governed by the contributions of these two streams since Chartiers Creek is the only other significant tributary to this reach.

At Rochester, the Beaver River makes a significant contribution (mean discharge = 3,250 cfs) to the flow of the Ohio River. The Beaver Basin is an intensively regulated area; it contains 713,000 acre-feet of storage space in a land area of 3,150 square miles. Flood control and low flow augmentation are dual purposes in the operation of five of the basin's seven major reservoirs. Milton Reservoir is operated for low flow augmentation alone (see Table 2.1.5.-11).

Table 2.1.-17 depicts the hydrologic characteristics of streams at the major USGS gaging stations in the Ohio and Beaver Basins. Table 2.1.-18 presents the flow-duration characteristics at many of these same stations. Flow-duration of the Ohio main stem at the Sewickley gage is graphed in Figure 2.1.5.-5.

Annual runoff within Sub-basin #20 ranges from 14 inches in the west to areas yielding approximately 20 inches in the east (24). However, individual sites, such as the Ohio River at Sewickley may yield annual runoffs as high as 22.5 inches. Table 2.1.5.-17 includes annual runoff data for this sub-basin.

T A B L E 2.1.5. - 17

HYDROLOGIC CHARACTERISTICS OF OHIO RIVER MAIN STEM AND TRIBUTARIES

USGS STATION NUMBER	STREAM	LOCATION*	DRAINAGE AREA @ GAGE (sq. mi.)	PERIOD OF RECORD (wtr yr.)	AVERAGE ** DISCHARGE(cfs)	INSTANTANEOUS MAXIMUM (cfs) AND DATE (mo/yr)	MINIMUM DAILY (cfs) AND DATE (mo/yr)	INSTANTANEOUS MINIMUM (cfs) AND DATE (mo/yr)	AVERAGE ANNUAL RUNOFF (in)
855	Chartiers Cr.	Carnegie	257	1919-33, 1940-76	287	13,500-8/56	---	16-8/26,9/32	15.17
860	Ohio R.	Sewickley	19,500	1933-76	32,370	574,000-3/36	---	1,800-9/57	22.54
861	Big Sewickley Cr.	Ambridge	15.6	1967-76	17.7	2,540-7/75	---	0-often	15.41
1015	Shenango R.	Pymatuning Dam	167	1935-76	199	1,540-9/37	---	0.1-6/34	16.18
1025	Little Shenango R.	Greenville	104	1913-76	140	8,540-1/59	---	2.9-7/34	18.28
1028.5	Shenango R.	Transfer	337	1965-76	455	5,200-2/76	---	33-7/68	18.34
1035	Shenango R.	Sharpsville	584	1938-76	726	15,700-1/59	43-9/41	---	16.88
1055	Beaver R.	Wampum	2,235	1915-18, 1933-76	2,394	50,100-5/46	97-7,8/33	74-7/33	14.55
1060	Connoquenessing Cr.	Zelienople	356	1919-76	467	23,000-6/24	---	6-7/36	17.81
1065	Slippery Rock Cr.	Wurtemburg	398	1911-76	563	19,000-1/37	---	16-9/32	19.21
1075	Beaver R.	Beaver Falls	3,106	1935-76	3,545	69,900-1/59	---	---	15.50
1080	Raccoon Cr.	Moffatts Mill	178	1942-76	190	8,590-1/52	---	4.5-8/65	14.50
1111.5	Brush Run	Buffalo	10.3	1961-76	9.26	1,180-2/66	---	0-often	12.21
1300	Conneaut Cr.	Conneaut, OH	175	1923-34, 1950-61	257	17,000-1/59	---	0.2-7,8/33,8/34	19.95

* Pennsylvania locations unless otherwise designated
** Adjusted for storage where applicable

SOURCE: Adapted from U.S. Geological Survey (21).

TABLE 2.1.5. - 18

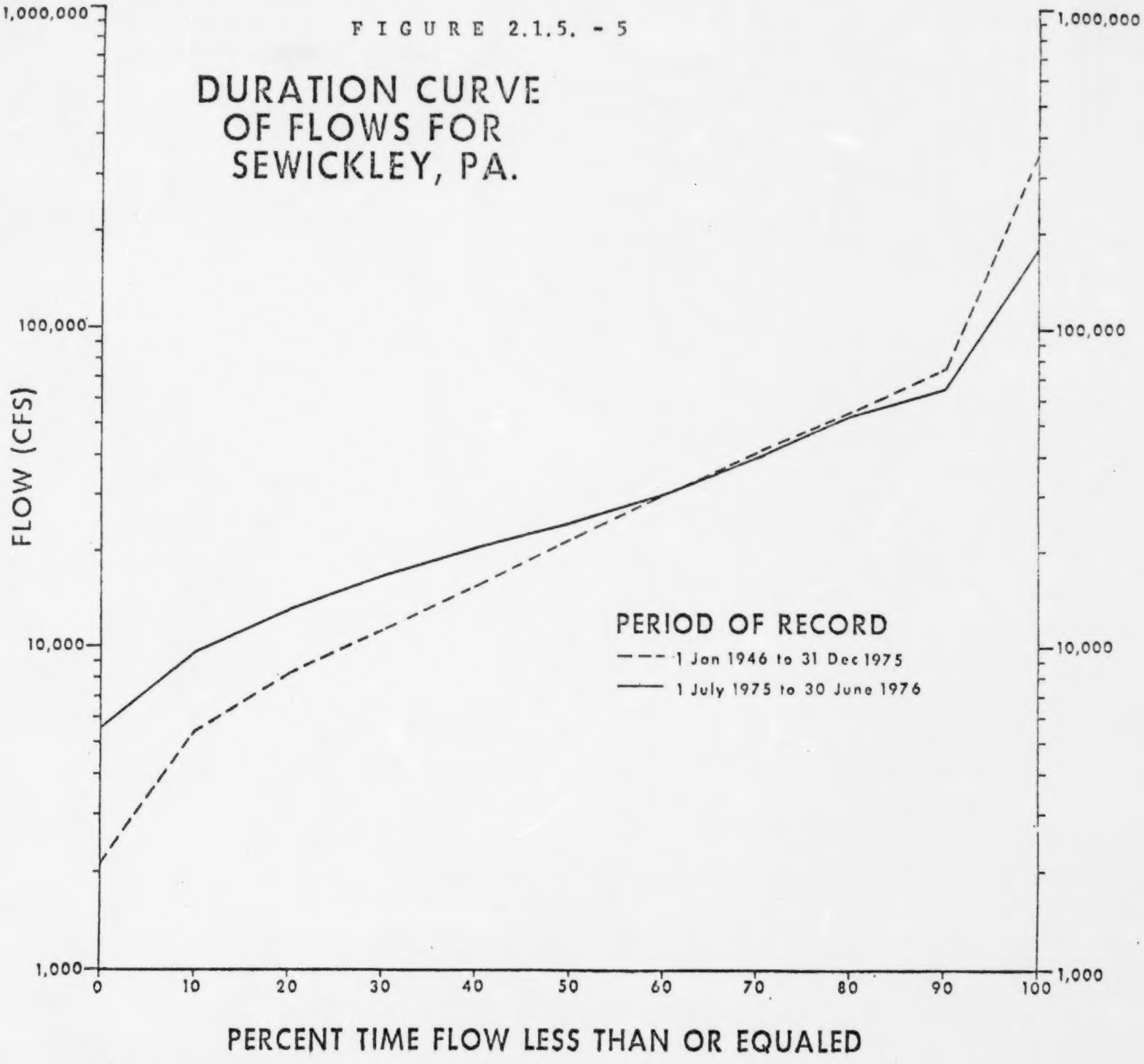
FLOW DURATION CHARACTERISTICS OF THE STREAMS IN THE UPPER OHIO BASIN (PA.)

STREAM	STATION	YEARS OF RECORD USED	Discharge in cubic feet per second which was equaled or exceeded for indicated percentage of time. 2	5	10	20	30	40	50	60	70	80	90	90	98
Shenango River	Turnerville	1913-22	1,300	730	470	280	170	110	77	53	30	16	8.7	6.7	5.1
Sugar Run	Pymatuning Dam	1941-60	92	46	25	12	7.0	4.3	2.5	1.3	0.6	0.3	0.08	0.02	0
Shenango R.	Pymatuning Dam	1935-60	850	680	500	280	220	190	150	110	75	36	10	3.8	2.0
Shenango R.	Jamestown	1920-33	1,200	840	600	370	230	140	96	58	32	16	8.2	5.4	4.0
Little Shenango	Greenville	1915-60	880	550	330	190	120	86	61	42	28	18	11	8.3	6.5
Shenango R.	Sharpsville	1939-60	3,600	2,400	1,800	1,100	770	510	360	290	250	210	170	130	110
Shenango R.	New Castle	1939-60	5,100	3,300	2,200	1,400	900	560	380	240	140	83	44	30	22
Beaver R.	Wampum	1933-60	13,000	8,300	5,700	3,300	2,200	1,600	1,200	980	820	630	450	340	220
Connoquenessing	Zelienople	1920-60	3,000	1,800	1,200	680	450	300	200	130	80	47	26	18	13
Slippery Rock	Wurtemburg	1912-63	3,100	2,000	1,400	840	540	370	260	170	120	84	59	47	38
Raccoon Cr.	Moffatts Mill	1942-60	1,100	700	460	290	200	140	98	68	47	31	19	14	10

SOURCE: Adapted from Busch and Shaw (28).

FIGURE 2.1.5. - 5

DURATION CURVE OF FLOWS FOR SEWICKLEY, PA.



SOURCE: ORSANCO (33).

Travel times during various flow regimes in four reaches of the upper Ohio River upstream of Cincinnati, Ohio have been calculated by the U.S. Geological Survey (34). Figure 2.1.5.-6 graphs the average times of travel as a function of flow at Cincinnati for each of these reaches. During low flow conditions, however, such calculations may be inaccurate due to the effects of wind action, diffusion, and lock operation.

B. Extreme Conditions

1. Floods

In the 46 years from 1900 to 1945, 64 floods occurred at Pittsburgh, an average of 1.4 floods* per year (35). Approximately 70% of these floods were experienced from January to March. Another analysis (3), extending back in time to 1885 has indicated that prior to the construction of flood-control reservoirs, Pittsburgh could anticipate high waters, which would cause at least minor flooding on an average of 1.3 times per year. Table 2.1.5.-19 lists the great floods of the major ORBES-Pennsylvania waterways from 1763 to 1963. Numerous floods of slightly less than maximum gage height have been purposely omitted to focus attention on the most severe episodes.

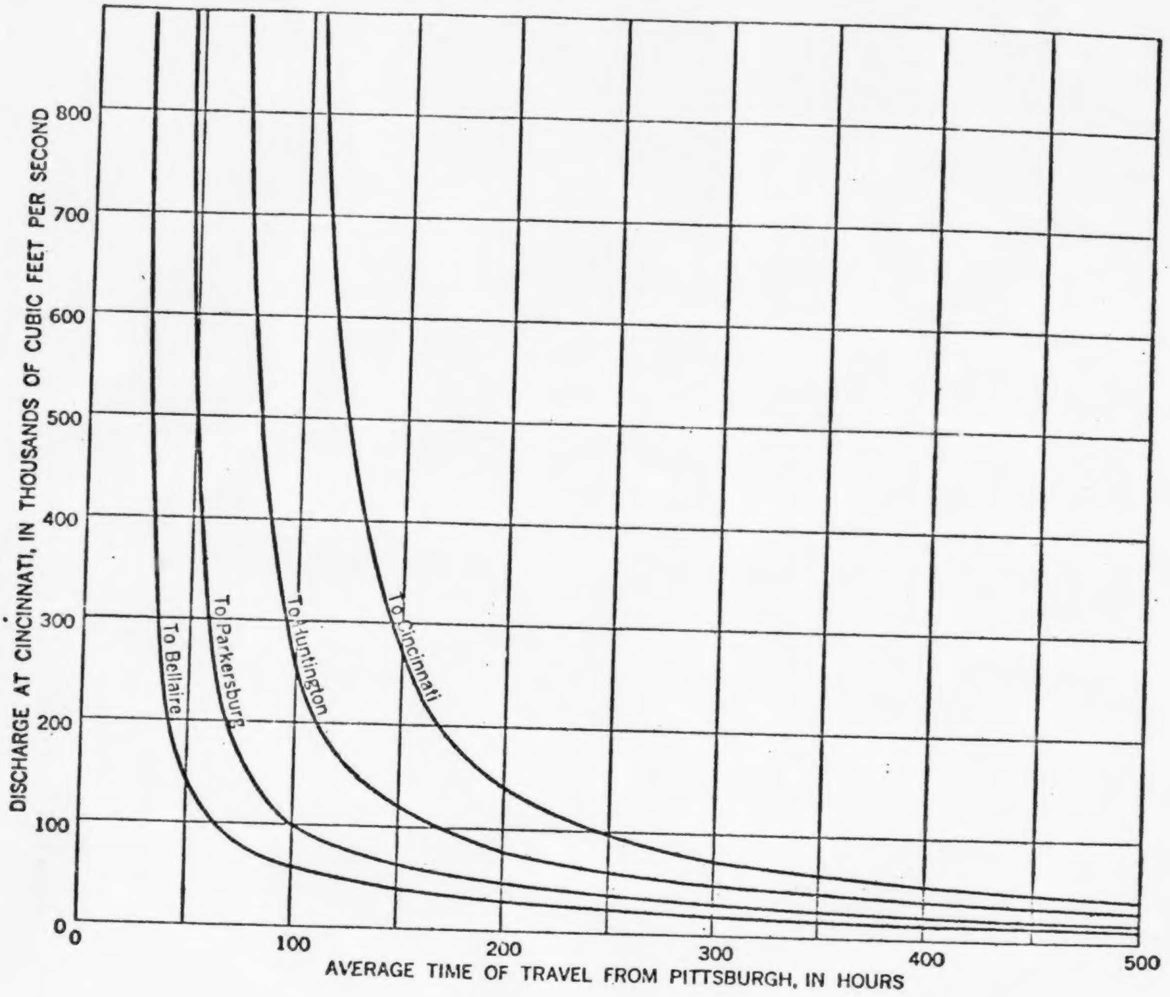
As early as 1912 the Pittsburgh Flood Commission had recommended construction of 17 flood-control reservoirs in the upper reaches of the Monongahela and Allegheny. However, no such projects were in operation in March of 1936 when the devastating and memorable "St. Patrick's Day Flood" hit Pittsburgh. Caused by a combination of river ice james, melting snow and rain, this flood remains the worst on record for the Pittsburgh metropolitan area. The flood crested at 46.0 feet, exceeding by 4.9 feet the previous record set in 1763. Although the upper reaches of the Monongahela and Allegheny rivers did not reach maximum flood stage, their tributaries near Pittsburgh (Red Bank Creek, Kiskiminetas River and Youghiogheny River were at record high levels concurrently (36).

---

*"Flood stage" is 25 feet at the Pittsburgh gage. No one knows exactly why this particular elevation was chosen; and it is meaningless today since no real damage occurs until the water level exceeds 27 feet, a level reached 43 times in the 46 year study period.

FIGURE 2.1.5. -6

RELATION OF DISCHARGE AT CINCINNATI TO
AVERAGE TRAVEL TIME OF WATER FROM PITTSBURGH



SOURCE: U.S. Geological Survey (34).

TABLE 2.1.5. - 19

GREAT FLOODS ON MAJOR RIVERS OF WESTERN PENNSYLVANIA

RIVER	STATION	DATES	GAGE HEIGHT (ft.)	COMMENTS
Monongahela	Charleroi	July 11, 1888 , 1887 March 18, 1936 October 16, 1954	26.1 24.5 22.47 21.07	Bankfull stage, 24' gage
Youghiogheny	Connellsville	August 21-22, 1888 March 14, 1907 March 29, 1924 March 18, 1936 October 16, 1954	17.8 18.4 20.5 20.28 21.96	Bankfull stage, 16' gage
Allegheny	Kittaning	April 10, 1806 March 18, 1865 February 5, 1883 March 20, 1905 March 26, 1913	30.0 29.5 29.0 28.8 30.7	Bankfull stage, 23' gage
Kiskiminetas	Avonmore	August 21, 1888 June 1, 1889 February 17, 1891 March 14, 1907 March 18, 1936	31.8 29.8 30.4 33.8 47.2	Floodstage, about 27' gage
Ohio	Pittsburgh	March 9, 1763 February 10, 1832 February 6, 1884 March 15, 1907 March 18, 1936	41.1 38.0 36.3 38.5 46.0	Floodstage, about 25' gage

SOURCE: Adapted from Shank (36).

Total damages wrought by the 1936 flood were greater than any previous or subsequent water disasters in the Pennsylvania-ORBES region. The Duquesne Light Company's power generating system, although designed to operate under flood conditions greater than those of past records, was unable to provide normal service to the City of Pittsburgh for eight days (37).

Flood-control reservoirs in the Monongahela and Allegheny Basins reduce flood crests by 2-4 feet and 4-10 feet respectively in each of the main stems from what would be normally expected without such flood control measures (9, 10). It has been estimated that the St. Patrick's Day Flood would have had its crest reduced by 10.1 feet at Pittsburgh, if only the first eight flood control reservoirs to be constructed were in operation in 1936 (3). This analysis does not even consider the additional reduction that would be afforded today by the presence of the large Allegheny Reservoir. Nonetheless, despite structural flood control measures, flood damages have exhibited a tendency to increase along with urbanization. This trend has been ascribed mainly to inadequate enforcement of flood plain regulations (38).

Information on flood discharges from several floods in the Allegheny and Monongahela Basins is presented in Tables 2.1.5.-20 and 2.1.5.-21. Tables 2.1.5.-22 and 2.1.5.-23 relate flood flows to surface elevation in these two rivers.

An examination of recorded high flow maxima reveals that floods can occur at virtually any time of the year. However, studies of the relationships between factors influencing flood occurrence (storm duration, intensity, affected area, and seasonality) indicate that the large streams tend to flood in the winter whereas small tributaries have a propensity to produce summer floods. Reich (39) demonstrated by analysis that Pennsylvania watersheds greater than 100 square miles had up to one-third of their annual floods in March. Regional storms bring abundant precipitation to the area in late winter and early spring. Furthermore, runoff

TABLE 2.1.5. - 20

ALLEGHENY RIVER
DISCHARGES FOR VARIOUS FLOODS

Station	Actual Discharge in 1,000 cfs			
	Jun. 1972	Jan. 1959	Mar. 1964	Mar. 1936
Lock and Dam No. 4 (Natrona Gage)	225.0	245.0	240.0	360.5
Lock and Dam No. 7 (Kittanning Gage)	189.3	207.7	213.8	201.9
Parker, Pa.	161.1	182.0	163.0	---
Franklin, Pa.	86.2	126.3	106.6	---

Source: U. S. Army Corps of Engineers (9).

TABLE 2.1.5. - 21

MONONGAHELA RIVER
DISCHARGES FOR VARIOUS FLOODS

Station	Actual Discharge in 1000 cfs		
	June 1972	March 1967	March 1963
Lock & Dam No. 2 Braddock Gage	180.0	178.0	163.0
Lock & Dam No. 4 Charleroi Gage	130.9	158.0	154.0
Maxwell Lock & Dam	120.0	158.0	154.0
Lock & Dam No. 7 Greensboro Gage	107.0	145.0	134.5
Morgantown Lock & Dam	31.1	85.0	77.0

Source: U. S. Army Corps of Engineers (10)

TABLE 2.1.5. - 22

FLOOD FLOWS AND ELEVATIONS[a]
ALLEGHENY RIVER

Flood Frequency	Stations			
	Lock & Dam No. 4 Natrona Gage	Lock & Dam No. 7 Kittanning Gage	Parker, Pa. Gage	Franklin, Pa. Gage
1 year flow (cfs)	93,000	90,000	70,000	50,400
Upper pool elevation (ft. above msl)	753.6	790.9	858.3	968.1
5 year flow (cfs)	139,000	132,500	107,000	72,000
Upper pool elevation (ft. above msl)	756.8	793.6	862.3	970.7
50 year flow (cfs)	210,000	196,000	157,000	110,000
Upper pool elevation (ft. above msl)	762.1	797.0	867.1	974.5
100 year flow (cfs)	233,000	215,500	173,000	121,500
Upper pool elevation (ft. above elevation)	763.4	798.2	868.3	975.8

---

[a] Flows and elevations based on existing basin development and existing river conditions (April 1975).

SOURCE: Adapted from U. S. Army Corps of Engineers (9).

TABLE 2.1.5. - 23

FLOOD FLOWS AND ELEVATIONS[a]
MONONGAHELA RIVER

	Stations				
Flood Frequency	Lock & Dam No. 2 Braddock Gage	Lock & Dam No. 4 Charleroi Gage	Lock & Dam No. 7 Greensboro Gage	Maxwell L/D	Morgantown L/D
1 year flow (cfs)	104,900	82,000	73,000	79,300	33,000
Upper pool elevation (ft. above msl)	730.0	745.4	788.2	---	---
Lower pool elevation (ft. above msl)	---	---	---	758.6	802.5
5 year flow (cfs)	145,000	119,300	107,500	115,800	55,000
Upper pool elevation (ft. above msl)	733.0	751.2	791.8	---	---
Lower pool elevation (ft. above msl)	---	---	---	765.4	806.7
50 year flow (cfs)	205,000	167,000	157,000	164,000	92,000
Upper pool elevation (ft. above msl)	738.4	757.8	798.2	---	---
Lower pool elevation (ft. above msl)	---	---	---	773.2	812.5
100 year flow (cfs)	220,800	182,500	168,000	178,100	104,000
Upper pool elevation (ft. above msl)	740.1	759.6	799.4	---	---
Lower pool elevation (ft. above msl)	---	---	---	775.3	814.0

---

[a] Flows and elevations based on existing basin development and existing river conditions (April 1975)

SOURCE: U.S. Army Corps of Engineers (10)

(snowmelt often included) is high due to the impervious state of the soil (saturated or frozen). Conversely, small watersheds were shown to have their highest probability of flooding in August. Such findings support the notion that small triubtary basins are susceptible to flash-flooding from local summer thundershowers.

Flash-floods are often partially attributed to steep topography. However, land use can substantially modify this tendency. Although the Allegheny Mountain Section of the Monongahela Basin is steeper than the Pittsburgh Plateau Section, a study comparing equivalent drainage areas in each section revealed insignificant differences in flood response (40). The higher degree of forestation in the more mountainous area is believed to be the equalizing factor. The effects of forest cover on hydrology are discussed in greater detail in Section 2.1.4. (Terrestrial Ecology).

2. Low Flow

Stream flow in the Appalachian Region is generally quite plentiful, averaging about 350 million gallons per year per square mile of drainage basin (41). Although low flow augmentation is a consideration in the release schedules of ten reservoirs that regulate stream flow in the Pennsylvania ORBES region, area waterways are nevertheless capable of developing flow deficiencies during periods of drought. An analysis of the annual cyclical variations in stream flow reveals that low flow conditions are most likely to occur in the late summer and early fall (August, September, October). Most USGS stations have their record minima logged for these months (see Tables 2.1.5.-12, 2.1.5.-14, 2.1.5.-17). When drought conditions persist, surface runoff is virtually nonexistant and small unaugmented streams rely almost totally on ground water for their flow. Unfortunately, the level of ground water storage is typically also at its lowest level during this time of the year.

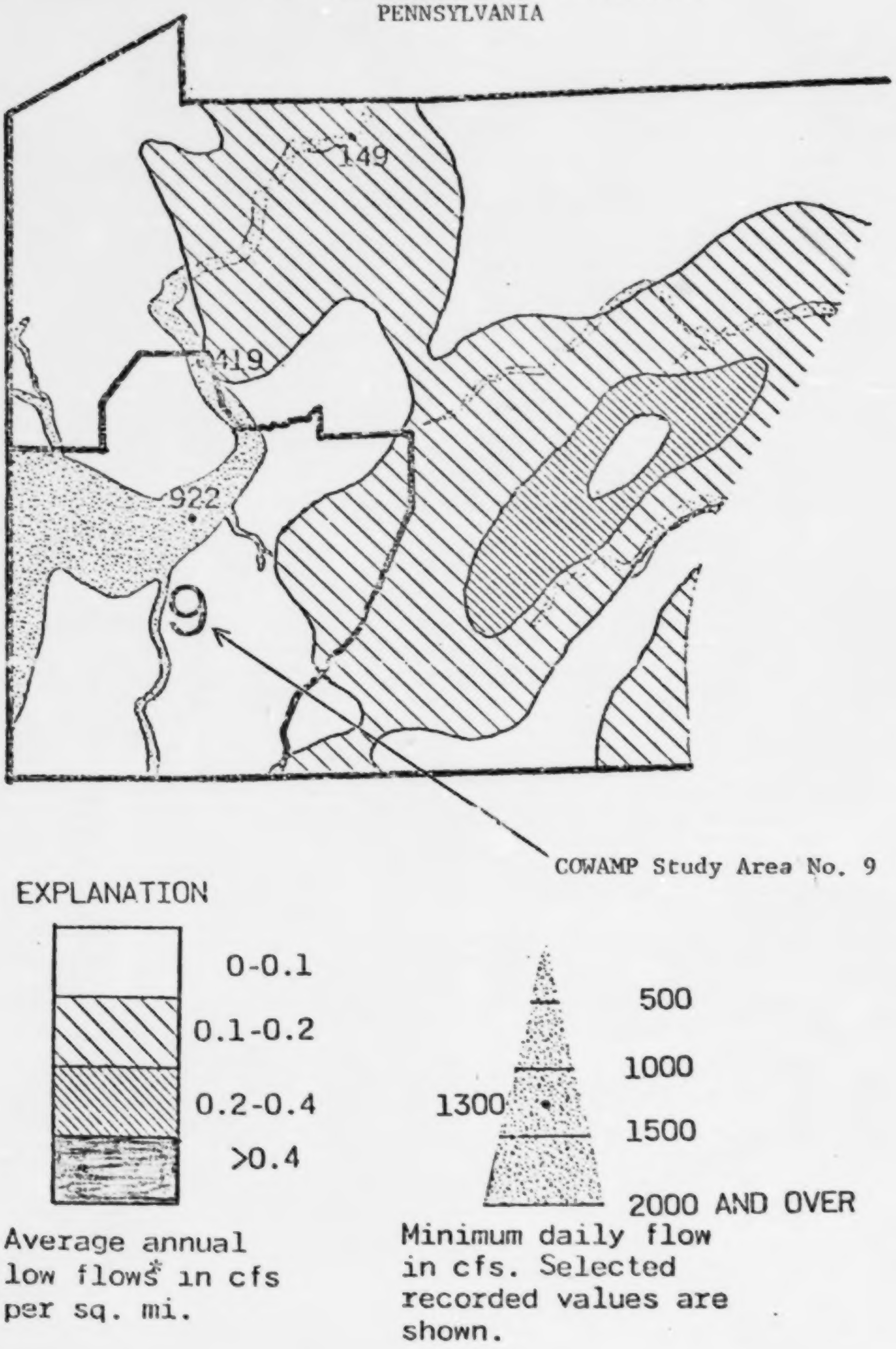
Minimum stream flows may vary substantially from one year to the next. Variations in low flow usually range from zero to about 1.2 cfs/sq. mi. within a two year period. A generalized geographic distribution pattern of average annual low flows is presented in Figure 2.1.5.-7.

The 7-day, 10-year low flow is a widely used basis for allocating waste loadings to a stream; it represents the flow expected to occur annually with a ten percent probability. Estimations of such flows for sites in each of the basins are given in Tables 2.1.5.-24, 2.1.5.-25 and 2.1.5.-26. More detailed statistical manipulations of low flow data including low flow frequency curves, yield-storage-frequency relationship curves, and low flows for various durations and recurrence intervals are available in two publications (28, 44) of the Pennsylvania Department of Environmental Resources.

The Ohio River Valley Water Sanitation Commission (ORSANCO) has noted that the activities of the Corps of Engineers have increased the 7-day, ten-year low flow of the Ohio River. Likewise, the minimum 7-day running averages of flow at Sewickley, Pennsylvania (r.m. 11.8) have been increased since 1967 due to the operation of the Allegheny Reservoir (see Fig. 2.1.5.-8). However, the 7-day running averages of flow at Sewickley have remained unaffected by releases from this large impoundment (see Fig. 2.1.5.-9). Moreover, trend analysis extending from 1953 to 1975 indicates no net change in flow.

FIGURE 2.1.5. - 7

LOW FLOW VARIABILITY IN WESTERN PENNSYLVANIA


149
419
922
9
COWAMP Study Area No. 9
EXPLANATION
0-0.1
0.1-0.2
0.2-0.4
>0.4
Average annual low flows* in cfs per sq. mi.
500
1000
1300
1500
2000 AND OVER
Minimum daily flow in cfs. Selected recorded values are shown.

* The flow below which a stream can be expected to recede on an average of every other year.

SOURCE: Green International, Inc. (41).

TABLE 2.1.5. - 24

7-DAY, 10-YEAR LOW FLOWS
IN THE MONONGAHELA RIVER BASIN

USGS Station Number	Stream	Location*	7 Day, 10 Year Low Flow
---	Monongahela R.	Pa.-W.Va. State Line	330
720	Dunkard Cr.	Shannopin	0.6
---	Cheat R.	Below Lake Lynn	38
725	Monongahela R.	Greensboro	400
730	South Fork Ten Mile Cr.	Jefferson	0.2
745	Redstone Cr.	Waltersburg	13
750	Monongahela R.	Charleroi	420
765	Youghiogheny R.	Friendsville, Md.	47
---	Youghiogheny R.	Above Reservoir	50
780	Casselman R.	Grantsville, Md.	1.0
790	Casselman R.	Markleton	14
800	Laurel Hill Cr.	Ursina	4.6
810	Youghiogheny R.	Confluence	220
825	Youghiogheny R.	Connellsville	240
---	Youghiogheny R.	Above Jacobs Cr.	245
835	Youghiogheny R.	Sutersville	310
---	Monongahela R.	Above Yough. R.	310
845	Turtle Cr.	Trafford	0.6
850	Monongahela R.	Braddock	1,000
---	Monongahela R.	Near Mouth	1,010

*Pa. location unless specified otherwise

---Extrapolations from existing USGS stations

SOURCE: Busch and Shaw (28) and Ohio River Basin Commission (42).

TABLE 2.1.5. - 25

7-DAY, 10-YEAR LOW FLOWS
IN THE
ALLEGHENY RIVER BASIN

USGS Station Number	Stream	Location*	7 Day, 10 Year Low Flows[a]	7 Day, 10 Year Low Flows[b]	Natural 7 Day, 10 Year Low Flows[c]
105	Allegheny R.	Eldred	23		
205	Oil Cr.	Rouseville	28		
240	French Cr.	Utica	60		
250	Sugar Cr.	Sugarcreek	15		
255	Allegheny R.	Franklin		2,500	470
280	West Br. Clarion R.	Wilcox	4.2		
	Clarion R.	Ridgway	26		
	Clarion R.	St. Petersburg	53		
325	Redbank Cr.	St. Charles	30		
340	Mahoning Cr.	Punxsutawney	15		
365	Allegheny R.	Kittanning		2,700	750 - 778
390	Crooked Cr.	Below Dam	4.3		
415	Conemaugh R.	Seward	165		
420	Blacklick Cr.	Josephine	25		
	Blacklick Cr.	Blacklick	23		
	Loyalhanna Cr.	New Alexandria	14		
490	Buffalo Cr.	Freeport	3.1		
495	Allegheny R.	Natrona		2,900	900 - 1,096

*Pennsylvania

SOURCES: a.) Busch and Shaw (28), periods of analysis specified therein; b.) U.S. Army Corps of Engineers (9); c.) Fed. Wtr. Poll. Cntrl. Admin.(14) and the U.S. Army Corps of Engineers (9), represents low flows without augmentation from reservoirs.

TABLE 2.1.5. - 26

7-DAY, 10-YEAR LOW FLOWS IN THE UPPER OHIO AND BEAVER BASINS

USGS Station Number	Stream	Location	7 Day, 10 Year Low Flow[a]	7 Day, 10 Year Low Flow[b]	Natural 7 Day, 10 Year Low Flow[c]
---	Ohio R.	Pittsburgh	5,050	6,555	
855	Chartiers Cr.	Carnegie	25		
860	Ohio R.	Sewickley		6,600	1,800
861	Big Sewickley Cr.	Ambridge	0.0		
995	Mahoning R.	Lowellville, OH	290		
1015	Shenango R.	Pymantuning Dam	14		
1025	Little Shenango R.	Greenville	5.4		
1028.5	Shenango R.	Transfer	29		
1035	Shenango R.	Sharpsville	81		
1055	Beaver R.	Wampum	270		
1060	Connoquenessing Cr.	Zelienople	10		
1065	Slippery Rock Cr.	Wurtemburg	30		
1075	Beaver R.	Beaver Falls	560		
1080	Raccoon Cr.	Moffatts Mill	7.4		
1111.5	Brush Run	Buffalo	0.0		

*Pa. location unless otherwise specified.

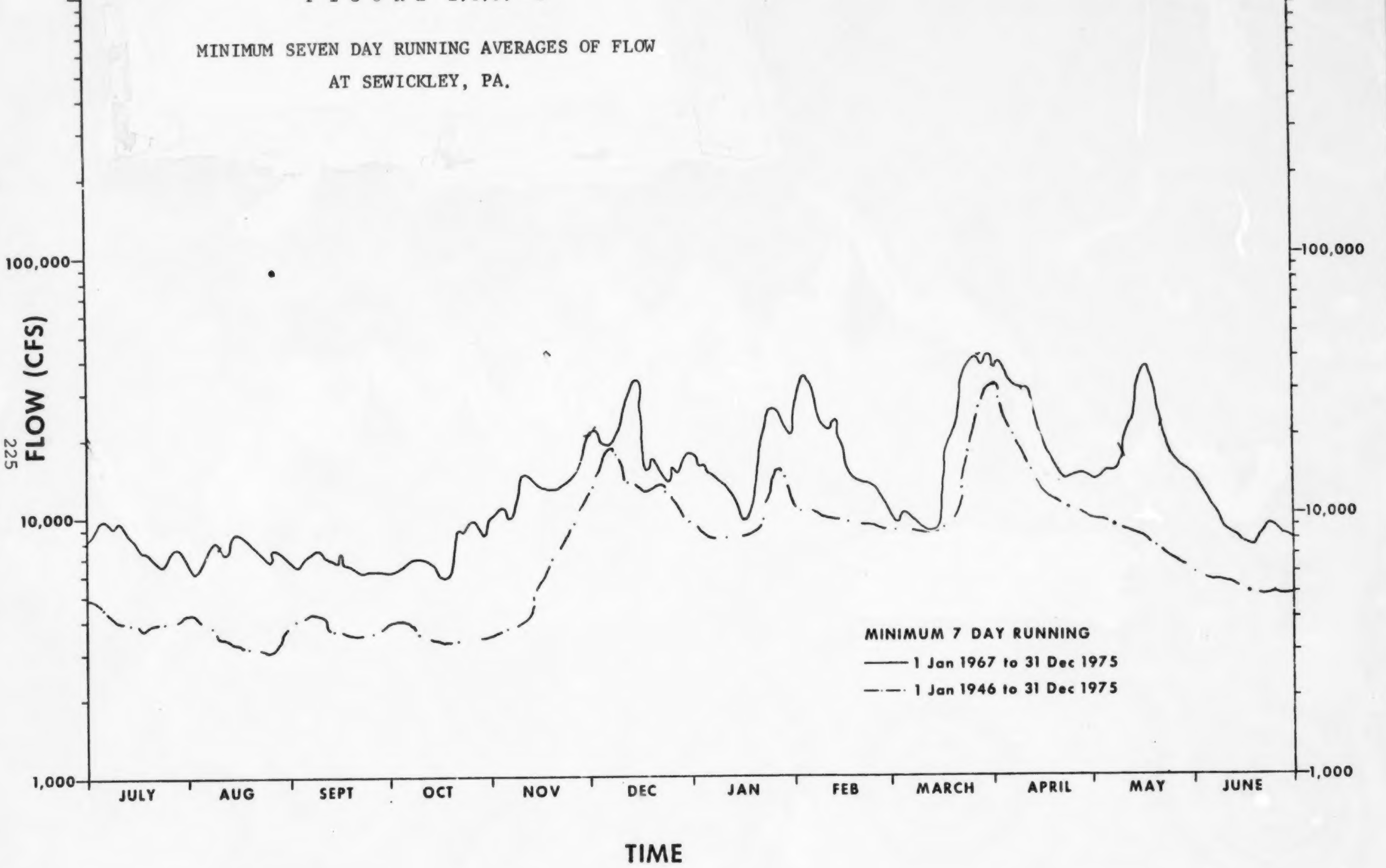
---Extrapolation from existing USGS stations.

a. The existing 7 day, 10 year low flow is that provided by the Army and represents the flow which would result from the 1968 A Reservoir System minus Rowlesburg Lake. SOURCE: Ohio River Basin Commission (22).

b., c. SOURCES: Brill (43) and the Ohio River Valley Water Sanitation Commission (33).

FIGURE 2.1.5.-8

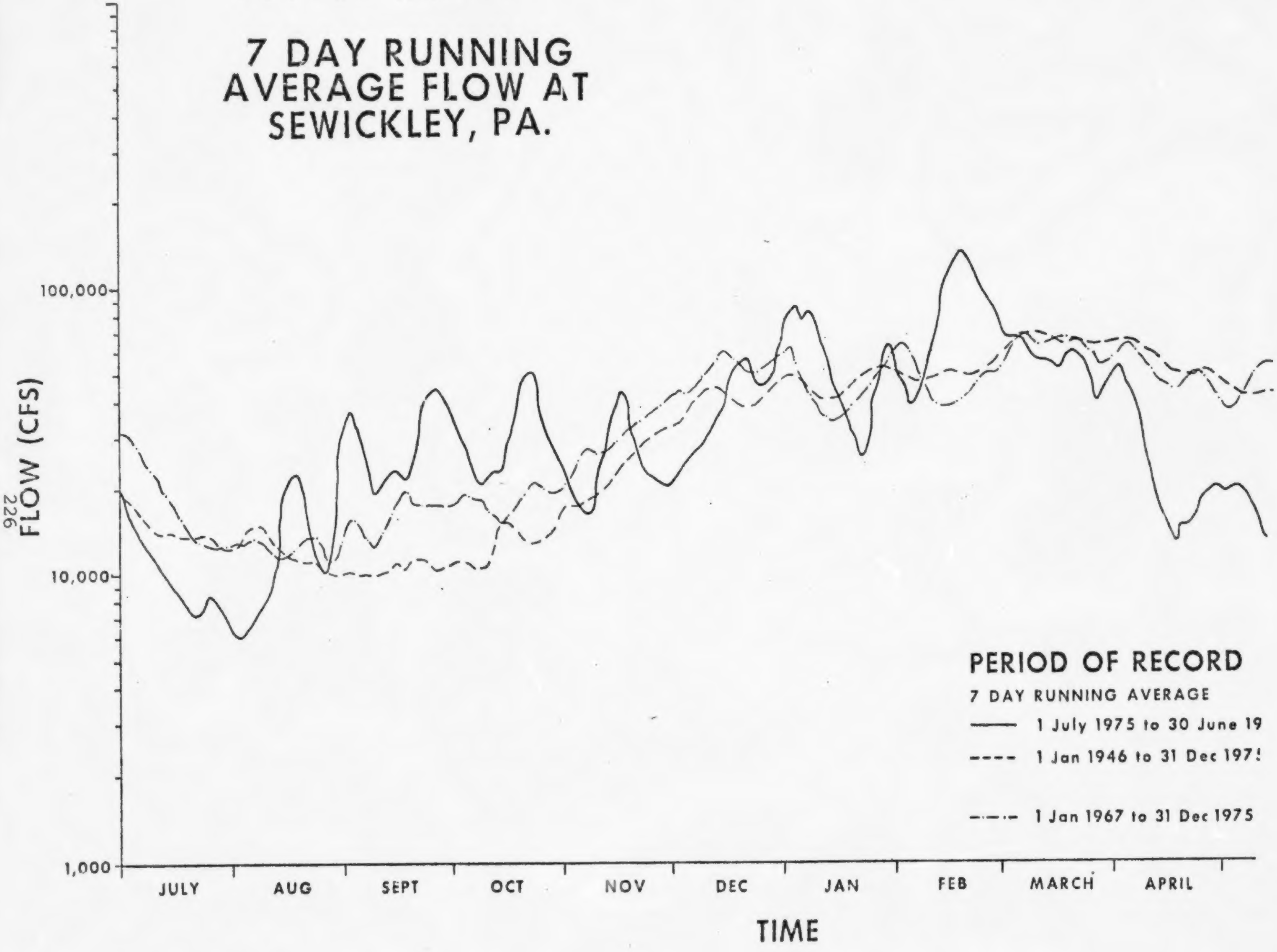
MINIMUM SEVEN DAY RUNNING AVERAGES OF FLOW
AT SEWICKLEY, PA.



SOURCE: ORSANCO (33)

FIGURE 2.1.5. -9

7 DAY RUNNING AVERAGE FLOW AT SEWICKLEY, PA.



SOURCE: ORSANCO (33).

REFERENCES

1. R.M. Leggette. "Ground Water in Northwestern Pennsylvania," Pa. Geol. Surv., 4th ser., bull. W3; 1936: 26.

2. M.G. Netting. "Geography of the Upper Ohio Valley." In: Man and the Waters of the Upper Ohio Basin." Special Publ. No. 1, Pymatuning Laboratory of Field Biology, University of Pittsburgh, 1956.

3. M. Noecker, D.W. Greenman, and N.H. Beamer. "Water Resources of the Pittsburgh Area, Pennsylvania" U.S. Geol. Surv., Circ. No. 315, Washington, D.C., 1954.

4. F. Leverett. "Glacial deposits outside the Wisconsin terminal moraine in Pennsylvania: Pennsylvania Dept. of Internal Affairs, Topog. and Geol. Survey Bull. G7, 1934.

5. A.B. Hulbert. The Ohio River. New York: G.P. Putnam and Sons, 1906.

6. R.E. Banta. The Ohio. H. Allen and C. Carmer (eds.), New York: Rinehart and Company, 1949.

7. R.T. Wiley, Monongahela - the river and its region. Ziegler Co.: Butler, Pa., 1937.

8. Z. Cramer - The Navigator. Pittsburgh: Zadock Cramer, 1814.

9. U.S. Army Corps of Engineers, Pittsburgh District. "Allegheny River, Pennsylvania - Final Environmental Statement on the Operation and Maintenance of the Navigation System." Pittsburgh: USCE, 1975.

10. U.S. Army Corps of Engineers, Pittsburgh District. "Monongahela River, Pennsylvania and West Virginia - Draft Environmental Statement on the Operation and Maintenance of the Navigation System." Pittsburgh: USCE, 1975.

11. Lt. C. Graham and Lt. J.M. Berrien. "Survey of the Allegheny River from Franklin to Pittsburgh." U.S. Army, 1928.

12. W.R. Howard. "Map of the Monongahela River from Pittsburgh to Brownsville, 1833.

13. J.K. Hoskins. "A Study of the Pollution and Natural Purification of the Ohio River - Section 1, Physiography." Public Health Bulletin 143 (1924): 15-18.

14. U.S. Department of the Interior, Federal Water Pollution Control Administration. "Framework Study of Water Supply and Water Pollution Control Problem Areas in the Ohio River Basin." Vol. 5, Appendix D of, "The Ohio River Basin Comprehensive Survey." Cincinnati, 1967.

15. U.S. Army Corps of Engineers, Pittsburgh District. "Monongahela River Navigation Projects Annual Water Quality Report, 1976." Pittsburgh: USCE, 1976.

16. Commonwealth of Pennsylvania, Department of Forests and Waters. "Dams, Reservoirs, and Natural Lakes." Water Resources Planning Inventory No. 1, Bureau of Engineering: Harrisburg, Pa., 1970.

17. U.S. Army Corps of Engineers, Pittsburgh District Office, Private Communication, April 20, 1978.

18. U.S. Army Corps of Engineers, Pittsburgh District Office, Private Communication, May 5, 1978.

19. L.C. Shaw and W.F. Busch. "Pennsylvania Gazetter of Streams, Part I" Water Resources Bulletin No. G, Pa. Dept. of Forests and Waters, Harrisburg, Pa. 1970.

20. H.W. Higbee. "Stream Map of Pennsylvania." Pennsylvania State University: University Park, Pa., 1965.

21. U.S. Geological Survey. "Water Resources Data for Pennsylvania - Water Year 1976." Vol. 3 Ohio River and St. Lawrence River Basins, Harrisburg, Pa., 1977.

22. Ohio River Basin Commission. "Upper Ohio Main Stem Comprehensive Coordinated Joint Plan." Cincinnati, 1978.

23. U.S. Department of the Interior, Federal Water Pollution Control Administration. "Ohio River Basin Comprehensive Survey, Vol 4 Appendix C-Hydrology." Cincinnati, 1967.

24. Commonwealth of Pennsylvania, Department of Environmental Resources. "Subbasin 20 - State Water Plan (draft copy)." Harrisburg, Pa., 1977.

25. U.S. Army Corps of Engineers, Pittsburgh District. "Ohio River-River and Harbor Projects-Summary of Pertinent Data." R/H 27-A, Pittsburgh, 1974.

26. U.S. Army Corps of Engineers, Pittsburgh District Office, Private Communication, May 1978.

27. Southwestern Pennsylvania Regional Planning Commission. "Suggested revisions to draft Monongahela Sub-basin Summary Report-II.B. Climate and Hydrology." Pittsburgh: SPRPC, 1975.

28. W.F. Busch and L.C. Shaw "Pennsylvania Streamflow Characteristics - Low Flow Frequency and Flow Duration." Water Resources Bulletin No. 1, Pennsylvania Department of Forests and Waters, 1966.

29. M.A. Shapiro, J.B. Andelman, and P.V. Morgan. "Intensive Study of the Water at Critical Points on the Monongahela, Allegheny and Ohio Rivers in the Pittsburgh, Pennsylvania Area." Report to Federal Water Pollution Control Administration PH-86-64-124, Grad. School of Public Health, University of Pittsburgh, 1967.

30. Commonwealth of Pennsylvania, Department of Environmental Resources. "Subbasin 18 - State Water Plan (draft copy)." Harrisburg, Pa., 1977.

31. Commonwealth of Pennsylvania, Department of Environmental Resources. "Subbasin 16 - State Water Plan (draft copy)." Harrisburg, Pa., 1977.

32. Commonwealth of Pennsylvania, Department of Environmental Resources. "Subbasin 17 - State Water Plan (draft copy)." Harrisburg, Pa., 1977.

33. Ohio River Valley Water Sanitation Commission (ORSANCO). "Assessment of Water Quality for the Ohio River Main Stem (draft and errata sheet)." Prepared for ORBC, Cincinnati, 1977.

34. U.S. Geological Survey. "Time of Travel of Water in the Ohio River - Pittsburgh to Cincinnati," U.S.G.S. Circular No. 439, Washington, D. C., 1961.

35. C.K. Harvey. "River Stages." Allegheny Conf. Digest, 1 (2): 11-12, 1945.

36. W.H. Shank. "Great Floods of Pennsylvania." Harrisburg: Buchart-Horn Consulting Engineers and Planners, 1968.

37. Anon. "Flood Issue." Public Service, R.S. McCarty (ed.), Pittsburgh: The Philadelphia Co., 25 (4): 1-6, 1936.

38. Commonwealth of Pennsylvania, Department of Environmental Resources. "Subbasin 19 - State Water Plan (draft copy)." Harrisburg, Pa., 1977.

39. B.M. Reich. "Seasonal Occurrenced Annual Floods in Small Pennsylvania Watersheds." Water Resources Bulletin, Vol. 7, No. 6. Harrisburg, Pa.: Pennsylvania Dept. of Environ. Resources, 1971.

40. B.M. Reich, Y.P. King, and E.L. White. "Flood Peak Frequency Design Manual PSU III." University Park, Pa.: Dept. of Civil Engineering, Pennsylvania State University, 1971.

41. Green International, Inc. "Comprehensive Water Quality Management Plan, Study Area 9, Chap. IV - Environmental Characteristics of the Study Area (Prelim. draft copy) Report prepared for Commonwealth of Pennsylvania, Dept. of Environ. Resources, Sewickley, Pa., 1976.

42. Ohio River Basin Commission. "Monongahela River Basin Water and Related Land Resources Study Report and Environmental Impact Statement." Cincinnati, 1975.

43. E.D. Brill, G.E. Stout, R.W. Fuessle, R.M. Lyon, and K.E. Wojnarowski. "Issues Related to Water Allocation in the Lower Ohio River Basin," Ohio River Basin Energy Study (ORBES) Special Study Report, Vol. III-G (U.S. EPA R-804821). Office of Energy, Minerals and Industry, U.S. EPA Washington, D.C., 1977.

44. Commonwealth of Pennsylvania, Department of Environmental Resources, Bureau of Engineering. "Long-Duration Low Flow of Pennsylvania Streams." Water Resources Bulletin No. 7, Harrisburg, Pa., 1972.

2.1.6. WATER QUALITY

2.1.6.1. INTRODUCTION

"The acceptability of a water's quality must be defined by using the beneficial use's quality requirements as a reference point, because quality standards differ according to use. What may be 'good' quality water for industrial purposes may be 'poor' quality for drinking purposes, and vice versa. Accordingly, water pollution is the degradation of quality to a degree that interferes with desired uses.

"Water quality problems in the study area date back to the 1800's. Continual improvements in many areas, such as forestry management, industrial waste treatment, and programs to reduce or eliminate mine drainage, have upgraded the general environmental quality of the area. However, greater pollution control is necessary to meet the desired goals set forth by the Pennsylvania Clean Stream Laws: to prevent further pollution and to restore polluted streams to clean condition, and to meet the mandates and goals of P.L. 92-500, Federal Water Pollution Control Act Admendments of 1972.

"Not only surface waters but also ground waters become degraded. Ground water quality depends on many factors - climatic changes, mineral composition of rock and soil, rate of circulation, and man's activities, especially mining, waste disposal, and ground water pumping.

"Pollutant discharges may be either from point sources or non-point sources. Point source pollution can be traced to a single, definitive point of discharge. Non-point source pollution comes from a diffuse area. Point sources include wastewater from municipal, industrial, and mine drainage treatment facilities, combined sewer overflows, and others. Non-point sources include agricultural and urban runoff, surface mining runoff, construction site runoff, salt water intrusion, and on-lot sewage disposal.

"Industries in this area discharge their wastewaters into municipal systems or into surface waters. Because of their quality and quantity, as well as their location on multiple-use streams, industrial discharges are potential threats to surface water quality.

"Heaviest concentrations of industrial discharges are in Allegheny County where 150 facilities discharge wastes into streams. An additional 250 facilities discharge to ALCOSAN on the Ohio River. The most concentrated area is along the Monongahela with most discharges originating from steel plants."

These excerpts are from "COWAMP - Comprehensive Water Quality Management Plan" (1) which is the State baseline study and plan for the quality of the water resources of Pennsylvania. The COWAMP Study Areas #8 and #9 cover most of the ORBES region in Pennsylvania and areas #5 and #6 include the remainder. A map showing the overlap of COWAMP Study Areas and the ORBES region is given in Figure 2.1.6.-1.

The "Study Areas" were adopted in the State Water Plan as the basic organizational structure. There are 10 study areas in the state, each covering a fairly uniform geographical region but with boundaries conforming to existing county boundaries. There are 19 counties in the PA ORBES region which are situated in the four different COWAMP Study Areas as shown in Figure 2.1.6.-1 and listed in Table 2.1.6.-1.

TABLE 2.1.6.-1
ORBES COUNTIES IN COWAMP STUDY AREAS

COWAMP Study Area #5

- Cambria Co.
- Somerset Co.

COWAMP Study Area #8

- Clarion Co.
- Elk Co. (western part)
- Forest Co.
- Jefferson Co.
- Lawrence Co.
- Mercer Co.
- Venango Co.

COWAMP Study Area #6

- Clearfield Co.
- Elk Co. (eastern part)

COWAMP Study Area #9

- Allegheny Co.
- Armstrong Co.
- Beaver Co.
- Butler Co.
- Fayette Co.
- Greene Co.
- Indiana Co.
- Washington Co.
- Westmoreland Co.

The basic planning units of the COWAMP studies, however, are the 20 sub-basins of the State numbered from 1 to 20. Each Sub-basin consists of a major watershed area, further subdivided into smaller watersheds designated by capital letters, such as 19A, 19B, 19C, etc. for Sub-basin 19.

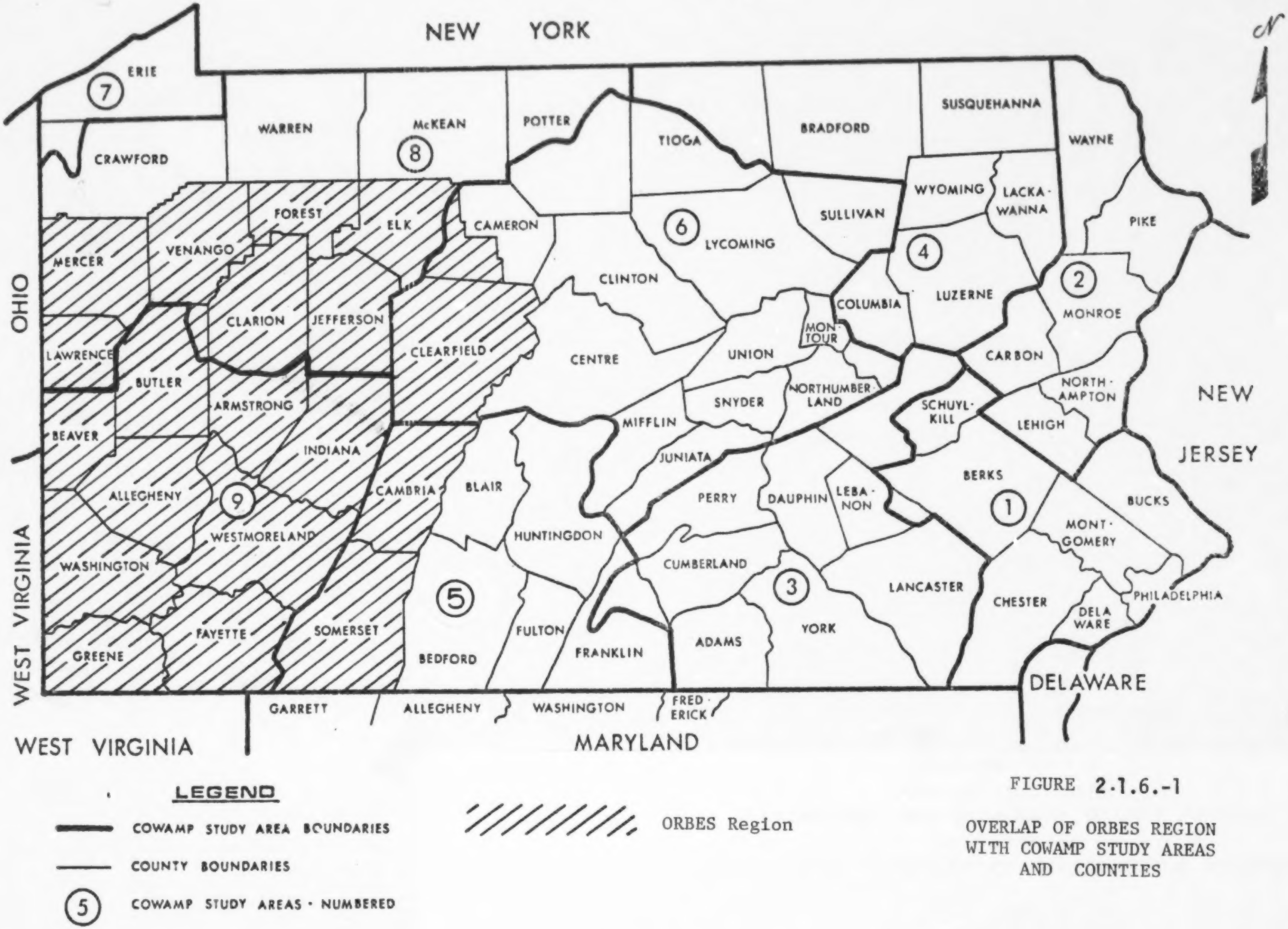

NEW YORK
N
ERIE
7
CRAWFORD
WARREN
McKEAN
8
POTTER
TIOGA
BRADFORD
SUSQUEHANNA
WAYNE
PIKE
MERCER
VENANGO
FOREST
ELK
CAMERON
LYCOMING
6
SULLIVAN
WYOMING
LACKA-WANNA
4
LUZERNE
2
MONROE
OHIO
LAWRENCE
CLARION
JEFFERSON
CLEARFIELD
CLINTON
CENTRE
UNION
MON TOUR
COLUMBIA
CARBON
BUTLER
ARMSTRONG
INDIANA
NORTHUMBER-LAND
SNYDER
MIFFLIN
SCHUYL-KILL
NORTH-AMPTON
LEHIGH
NEW JERSEY
BEAVER
JUNIATA
BERKS
1
ALLEGHENY
9
CAMBRIA
BLAIR
PERRY
DAUPHIN
LEBA-NON
BUCKS
WESTMORELAND
HUNTINGDON
MONT-GOMERY
WASHINGTON
CUMBERLAND
3
LANCASTER
CHESTER
5
PHILADELPHIA
DELA WARE
FAYETTE
SOMERSET
FULTON
YORK
GREENE
BEDFORD
FRANKLIN
ADAMS
DELAWARE
WEST VIRGINIA
GARRETT
ALLEGHENY
WASHINGTON
FRED-ERICK
MARYLAND
WEST VIRGINIA
LEGEND
COWAMP STUDY AREA BOUNDARIES
COUNTY BOUNDARIES
5 COWAMP STUDY AREAS - NUMBERED
ORBES Region

FIGURE 2.1.6.-1

OVERLAP OF ORBES REGION
WITH COWAMP STUDY AREAS
AND COUNTIES

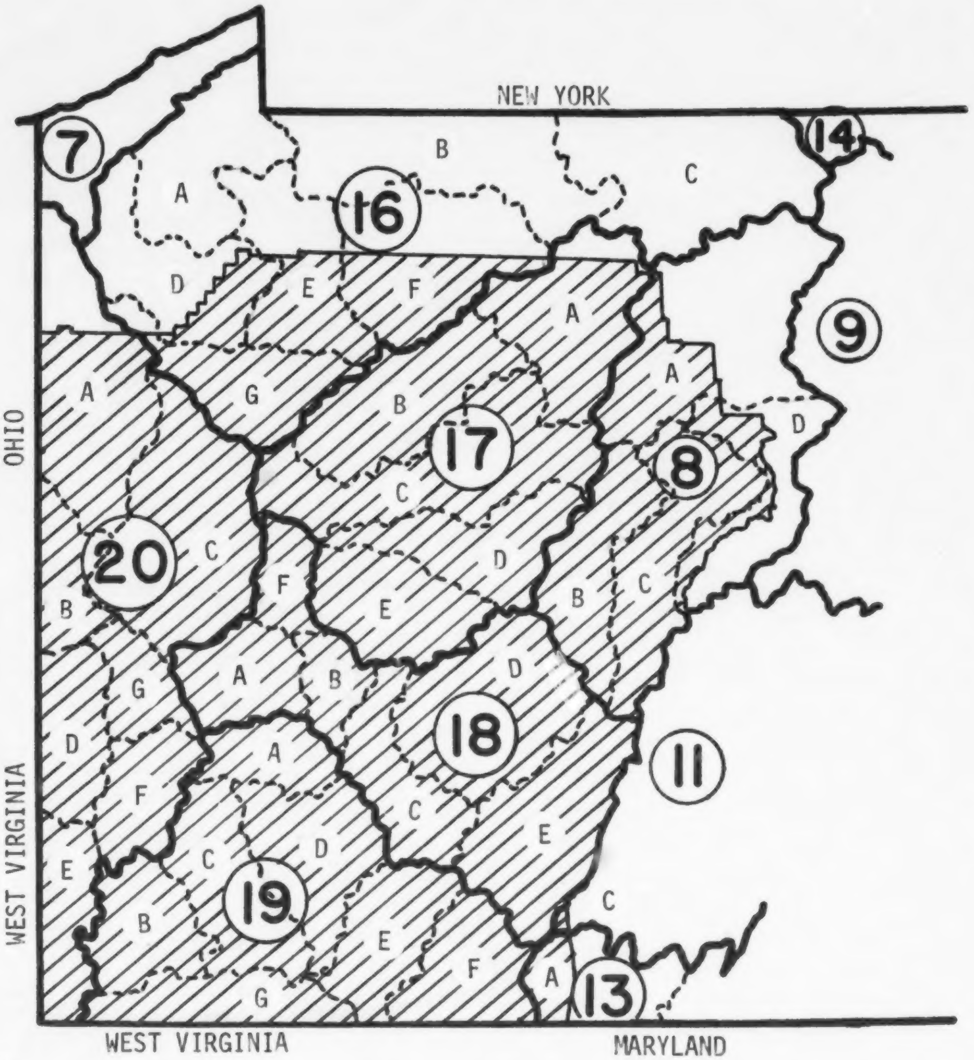
The PA ORBES region overlaps parts of eight sub-basins, as shown in Figure 2.1.6.-2:

- Western part of Sub-basin 8 - Upper West Branch Susquehanna Sub-basin
- Western-most tip of Sub-basin 11 - Upper Juniata Sub-basin
- Western-most tip of Sub-basin 13 - Potomac Sub-basin
- Southern part of Sub-basin 16 - Upper Allegheny Sub-basin
- Sub-basin 17 - Central Allegheny (except its northern tip)
- Sub-basin 18 - Lower Allegheny Sub-basin
- Sub-basin 19 - Monongahela Sub-basin
- Sub-basin 20 - Ohio Sub-basin (except its northern tip)

Much of the material in this chapter on baseline data for water quality in Pennsylvania is taken from the COWAMP reports (References 1,2,3,4) as it applies to the ORBES region. These reports contain a wealth of valuable information on many aspects of water use and quality in the ORBES Region, particularly large-size plates which accompany the various chapters. A list of the most pertinent plates in the COWAMP reports is given in Table 2.1.6.-2 for reference. The small portions of Sub-basins 8,11,and 13 which are included in the ORBES Region are actually not part of the Ohio River Basin and only limited amount of information will be presented for these areas in this report.

FIGURE 2.1.6.-2

OVERLAP OF ORBES REGION WITH COWAMP SUBBASINS


NEW YORK
OHIO
WEST VIRGINIA
WEST VIRGINIA
MARYLAND
7
14
16
9
17
8
20
18
11
19
13

COWAMP SUB-BASINS IN ORBES REGION

- ⑧ Upper West Branch Susquehanna
- ⑪ Upper Juniata Sub-basin
- ⑬ Potomac Sub-basin
- ⑯ Upper Allegheny Sub-basin
- ⑰ Central Allegheny Sub-basin
- ⑱ Lower Allegheny Sub-basin
- ⑲ Monongahela Sub-basin
- ⑳ Ohio Sub-basin

LEGEND

━━━━ - - - - - -	COWAMP SUB-BASIN BOUNDARY
⑧	COWAMP SUB-BASIN - NUMBERED
────	ORBES REGION BOUNDARY
▨	ORBES REGION

TABLE 2.1.6.-2

LIST OF PERTINENT PLATES IN COWAMP REPORTS

COWAMP STUDY AREA #5 (3)

Plate	Title
IV-6	Selected Stream Gaging Stations
IV-9	Groundwater Degradation and Critical Recharge Areas
VI-1	Major Streams and Water Quality Sampling Points
VI-2	Existing Aquatic Environments
VI-3	Public and Industrial Water Use
VI-4	Domestic Ground Water Use
VI-5	Agricultural Water Use
VI-6	Recreational Water Use
VI-7	Water Based Power Generation
VI-8	Wastewater Treatment Facilities and Untreated Discharges
VI-9	Water Use Totals and Available Resources
VI-10	Water Resources Development Projects
VI-11	Documented Acid Mine Drainage Discharge Points
VI-12	Ground Water Quality Problem Areas
VI-13	Surface Water Quality Problem Areas
VI-14	Ground Water Sampling Points
VI-15	Ground Water Quality by Hydrogeological Group
VI-16	Elevated Chemical Parameters in Ground Water Sampling Points
VI-17	Stream Use Classifications
VI-18	Water Quality Criteria Classification
VI-19	Effluent Limitation Zones
VII-1	Wastewater Treatment Facilities and Untreated Discharges
VII-2	Coal Mining Areas
VII-3	Coal Operating Wastewater Treatment Facilities
VII-4	Existing and Presently Planned Sewered Areas
VII-5	Landfills, Unlined Lagoons, and Spray-Irrigation Sites

TABLE 2.1.6.-2 Continued

COWAMP STUDY AREA #6 (4)

Plate	Title
IV-9	Potential Ground Water Yield
IV-10	Potential Ground Water Recharge Areas
VI-1	General Study Area Map
VI-2	Public Water Systems
VI-3	Non-Public Water Uses
VI-4	Existing Reservoir Development
VI-5	Potential Ground-Water Yields and Pumping Areas
VI-6	Surface Water Quality Monitoring
VI-7	Water Quality Problems
VII-1	Existing and Planned Municipal Wastewater Treatment Systems
VII-2	Existing Industrial and Non-Municipal Wastewater Treatment Facilities
VII-3	Active Coal Mine Locations
VII-4	Malfunctioning On-Lot Disposal Areas
VII-5	Existing and Planned Land Disposal Locations

COWAMP STUDY AREA #8 (1)

IV-14	Ground Water Use
IV-15	Ground Water Availability
IV-18	Abandoned Deep Coal Mines
IV-19	Degraded Surface Waters
IV-20	Areas of Known or Potential Ground Water Degradation
VI-1	Hydrologic Basins
VI-2	Water Supply Treatment Facilities, Sources, and Service Areas

TABLE 2.1.6.-2 Continued

COWAMP STUDY AREA #8 (1)	
Plate	Title
VI-3	Ground Water Pumpage
VI-4	Stream Use Designations
VI-5	Water Quality Monitoring Points
VI-6	Surface Water Classification
VI-7	Location of United States Geological Survey - Ground Water Sampling Points
VII-1	Municipal and Non-municipal Wastewater Treatment Facilities
VII-2	Septic Tank Concentrations
VII-3	Industrial Wastewater Discharges
VII-4	Mine Drainage Treatment Facilities
VII-5	Solid Waste Sites
VII-6	Existing Monitoring Stations
COWAMP STUDY AREA #9 (2)	
IV-15	Ground Water Use
IV-16	Ground Water Availability
IV-23	Abandoned Deep Mines
IV-24	Degraded Surface Waters
IV-25	Areas of Known or Potential Ground Water Degradation
VI-1	Hydrologic Basins
VI-2	Water Supply Treatment Facilities, Sources, and Service Areas
VI-2a	High Detail - Water Supply Treatment Facilities and Sources
VI-3	Ground Water Pumpage

TABLE 2.1.6.-2 Continued

COWAMP STUDY AREA #9 (2)

Plate	Title
VI-4	Stream Use Designations
VI-5	Water Quality Monitoring Points
VI-6	Surface Water Classification
VI-7	Location of USGS Ground Water Sampling Points
VII-1	Municipal Wastewater Treatment Facilities
VII-2	Non-municipal Wastewater Treatment Facilities and Raw Discharges, and Municipal Raw Discharges
VII-3	Septic Tank Concentrations
VII-4	Industrial Wastewater Discharges and Spray Irrigation Facilities
VII-5	Industrial Wastewater Discharges
VII-6	Industrial Wastewater Discharges
VII-7	Deep Mine Drainage Treatment Facilities - Surface Mine Drainage Treatment Facilities
VII-8	Solid Waste Sites and Treatment Facilities
VII-9	Water Quality Monitoring Points

2.1.6.2. WATER QUALITY DATA SOURCES

Water quality data in the PA ORBES region are collected by several agencies. These include:

- PA Department of Environmental Resources
- PA Fish Commission
- PA Western Conservancy
- U.S. Environmental Protection Agency
- U.S. Geological Survey
- U.S. Department of Agriculture
- U.S. Coast Guard
- U.S. Army Corps of Engineers
- ORSANCO
- Pittsburgh Naval Reactors
- County Health Departments
- local water and wastewater treatment agencies
- conservation groups and watershed associations
- industries

Much of the sampling is irregular, conducted for a specific, temporary reason and provides only limited information for a short time period. There are a few major monitoring networks which will be described briefly below but many of the reports and publications from short-term studies will be used in the discussion.

The U.S. Geological Survey (USGS) is concerned with chemical and physical characteristics of the surface and ground water supplies of the Nation. Most of its investigations are carried out in cooperation with State, municipal, and other Federal agencies. USGS has published the records of chemical quality, temperature, and suspended sediment of surface waters from 1941 to 1970 in an annual series of water-supply papers entitled "Quality of Surface Waters of the United States". To meet interim requirements, for water years 1964 through 1974, water quality records have also been released by the USGS in annual reports for each state. For PA these reports are entitled "Water Resources Data for Pennsylvania, Part 2. - Water Quality Records". Beginning with the 1975 water year, data for streamflow, surface water quality, and ground water are published as an official" USGS Water-Data Report" on a State-boundary basis entitled "Water Resources Data for Pennsylvania - Water Year X".

USGS, in cooperation with the PA Bureau of Topographic and Geologic Survey of DER, has also been sampling and analyzing public, private, and industrial spring and well waters at various locations since about 1930. The results have been published by the PA Bureau of Topographic and Geologic Survey in ground water reports or bulletins of their W series.

The PA Department of Environmental Resources (DER) Bureau of Water Quality Management has collected and analyzed water quality samples throughout the state as part of the PA Water Quality Network (WQN) (5) since 1962. Beginning with the 1976 water year the results are included in the "Water Resources Data for Pennsylvania" published by USGS. At this time records of samples collected prior to October 1975 are available only through the DER but will be published in the future as a separate data report.

The data are also entered into computerized information retrieval networks: Pennsylvania's Water Quality Management Information System (WAMIS), and the U.S. Environmental Protection Agency's STORET. These data can be accessed by means of station's Water Quality Network number (PA-DER WQN No.) or the 8-digit downstream-order station number assigned by USGS (EPA/USGS No.). About 55 parameters are stored in STORET for each WQN station and these can be retrieved along with the dates on which the sampling took place or the mean, variance, standard deviation, maximum and minimum values of each parameter can be calculated for any time period and outputted along with the number of samples involved.

There are approximately 300 WQN stations in the state where samples are collected regularly, on a monthly or quarterly basis. Twenty-five chemical indicators are analyzed for each sample but biological monitoring has also been established at some of the stations. Heavy metal analysis is performed once a year during low flow conditions. There are also a number of partial record stations where samples are collected irregularly and only a few analyses are performed on the samples.

The Bureau of Water Quality Management also samples and analyses the raw water quality of all ground water sources prior to issuing a permit for public water supply use. After issuance of the permit, raw water samples are generally taken only when a problem arises or if treatment is not normally provided.

Other bureaus of DER perform less extensive monitoring, oriented toward their own need. Thus, the Bureau of Surface Mine Reclamation collects surface and ground water quality data affected by surface mining activities. The sampling begins prior to issuing a surface mining permit, continues throughout the activity and extends into the reclamation period. The Bureau of Community Environmental Control monitors the water quality of certain semi-public waters (State parks, restaurants, schools, institutions, public swimming and bathing places, etc) and the Bureau of Land Protection monitors the ground water at landfill sites, wastewater lagoons, and similar facilities. None of the data collected by these bureaus is fed into any computer system at the present time.

The Ohio River Valley Water Sanitation Commission (ORSANCO), an instrument of an eight-state compact, maintains a comprehensive water quality monitoring network on the Ohio River and the lower reaches of its major tributaries. It has more than 25 robot monitors in operation, six of which are in the PA-ORBES Region. The robots continuously monitor only four parameters (temperature, conductivity, dissolved oxygen, and pH) of which the daily averages are computer-calculated and these data are available on computer printouts (6). Samples at major stations are also collected manually on a bi-weekly basis and analyzed for 30 additional parameters, including heavy metals. Recent concern with discharges of toxic chemicals has caused a drastic change in the Commission's monitoring program to include organic substances, such as PCB's and pesticides in fish, river water, and sediment. A statistical summary of the robot monitor data and the results of some other water quality analyses are published monthly (7).

Table 2.1.6.-3 lists all surface water quality sampling stations operated by the above listed monitoring networks within the PA-ORBES Region. Included are seven ORSANCO stations (one of which has been discontinued), five EPA Primary Stations, and 86 WQN Stations (16 of which have recently been discontinued). The locations of these sampling stations are shown in Figures 2.1.6.-3 through 2.1.6.-7.

TABLE 2.1.6.-3 SURFACE WATER QUALITY SAMPLING LOCATIONS

PA-DER WQN NO.	STREAM	COWAMP SUB-BASIN	LOCATION	EPA/USGS NO.
	MONONGAHELA RIVER BASIN			
(b)(c)	Monongahela River	19C	Charleroi, Washington Co.	
(b)	Monongahela River	19A	S. Pittsburgh, Allegheny Co.	
701 (a)	Monongahela River	19A	Braddock, Allegheny Co.	850
702	Monongahela River	19C	Charleroi, Washington Co.	750
703 (a)	Monongahela River	19G	Greensboro, Greene Co.	725.50
704	Turtle Creek	19A	Trafford, Westmoreland Co.	845
705	Abers Creek	19A	Plum Boro, Allegheny County	840
706	Youghiogheny River	19D	Sutersville, Westmoreland, Co.	835
707	Youghiogheny River	19D	Connellsville, Fayette Co.	825
708 (c)	Youghiogheny River	19E	Ohiopyle, Fayette Co.	815
709	Youghiogheny River	19F	Youghiogheny Dam, Somerset Co.	775
710	Casselman River	19F	Markleton, Somerset Co.	790
712	Redstone Creek	19C	Franklin Twp., Fayette Co.	745
713	South Fork Ten Mile Creek	19B	Jefferson, Greene Co.	730
714	Dunkard Creek	19G	Dunkard Twp., Greene Co.	720
715	Sewickley Creek	19D	Hunker, Westmoreland Co.	832.50
716(c)	South Fork Ten Mile Creek	19B	Clarksville, Greene Co.	735.35
717	Ten Mile Creek	19B	E. Bethlehem Twp., Washington Co.	736
718	Pigeon Creek	19C	Carroll Twp., Washington Co.	750.40
719	Peters Creek	19C	Jefferson Borough, Allegheny Co.	750.90
720(c)	Turtle Creek	19A	Franklin Twp., Westmoreland Co.	839.75
721	Jacobs Creek	19D	Scottsdale Boro, Westmoreland Co.	830.38
722(c)	Casselman River	19F	Harnedsville, Somerset Co.	792
723	Big Sandy Creek	19G	Wharton Twp., Fayette Co.	704
724	Laurel Hill Creek	19E	Confluence, Somerset Co.	800
725	Monongahela River	19G	Point Marion, Fayette Co.	630

TABLE 2.1.6.-3(Continued)

PA-DER WQN NO.	STREAM	COWAMP SUB-BASIN	LOCATION	EPA/USGS NO.
UPPER ALLEGHENY RIVER BASIN				
804(a.)	Allegheny River	16G	Franklin, Venango Co.	255
805	Allegheny River	16F	Harmony Twp., Forest Co.	160
826	French Creek	16D	Utica, Venango Co.	240
828(c)	Oil Creek	16F	Rouseville, Venango Co.	205
829	Tionesta Creek	16F	Tionesta Twp., Forest Co.	200.50
830	Tionesta Creek	16F	Howe Twp., Forest Co.	175
845	French Creek	16D	Franklin, Venango Co.	254.90
848(c)	Lake Creek	16D	Jackson, Twp., Venango Co.	242.30
852	Oil Creek	16E	Oil City, Venango Co.	210.50
853(c)	Tionesta Creek	16F	Tionesta Twp. Forest Co.	200.05
MIDDLE ALLEGHENY RIVER BASIN				
802	Allegheny River	17E	Kittanning Twp., Armstrong Co.	365
803	Allegheny River	17C	Hovey Twp., Armstrong Co.	315
818	Crooked Creek	17E	Bethel Twp., Armstrong Co.	390.10
819	Mahoning Creek	17D	Redbank Twp., Armstrong Co.	360
820	Redbank Creek	17C	Porter Twp., Clarion Co.	325
821	Clarion River	17B	Piney Twp., Clarion Co.	305.15
822	Clarion River	17B	Farmington Twp. Clarion Co.	295.
823	Clarion River	17A	Johnsonburg, Elk Co.	285
824	W. Branch Clarion River	17A	Jones Twp., Elk Co.	280
825	E. Branch Clarion River	17A	Jones Twp., Elk. Co.	275.45
833	Clarion River	17A	Ridgway, Elk Co.	290
835(c)	Mahoning Creek	17D	Punxsutawney, Jefferson Co.	340
836(c)	Little Mahoning Creek	17D	McCormic, Indiana Co.	345
837(c)	Crooked Creek	17E	South Bend Twp., Armstrong Co.	380
841	Cowanshannock Creek	17E	Valley Twp., Armstrong Co.	364
842(c)	Mahoning Creek	17D	Pine Twp., Armstrong Co.	361
843	Clarion River	17B	Richaland Twp., Clarion Co.	310

TABLE 2.1.6.-3 (Continued)

PA-DER WQN NO.	STREAM	COWAMP SUB BASIN	LOCATION	EPA/USGS NO.
MIDDLE ALLEGHENY RIVER BASIN (continued)				
844	Elk Creek	17A	Ridgway, Elk Co.	289
859	Little Toby Creek	17A	Portland Mills, Elk Co.	291.70
LOWER ALLEGHENY RIVER BASIN				
(b)	Allegheny River	18A	Oakmont, Allegheny Co.	
(b)	Allegheny River	18F	Lock &Dam No. 5, Armstrong Co.	
(b)	Kiskiminetas River	18B	Vandergrift, Westmoreland Co.	
801(a)	Allegheny River	18A	New Kensington, Westmoreland Co.	496.25
808	Buffalo Creek	18F	S. Buffalo Twp., Armstrong Co.	489
809	Kiskiminetas River	18B	Vandergrift, Westmoreland Co.	485
810	Conemaugh River	18C	Conemaugh Twp., Indiana Co.	440
811	Conemaugh River	18D	Seward, Westmoreland Co.	415
812	Loyalhanna Creek	18C	Loyalhanna Twp., Westmoreland Co.	470
813	Loyalhanna Creek	18C	Unity Twp., Westmoreland Co.	449.97
814	Black Lick Creek	18D	Burrell Twp., Indiana Co.	420
815	Two Lick Creek	18D	Center Twp., Indiana Co.	425.05
816	Little Conemaugh River	18E	Franklin, Cambria Co.	410.25
817	Stony Creek	18E	Ferndale, Cambria Co.	400
838	Pine Creek	18A	Hampton Twp., Allegheny Co.	497.50
839	Deer Creek	18A	West Deer Twp., Allegheny Co.	496.45
840(c)	Buffalo Creek	18F	Clearfield Twp., Butler Co.	488.50

TABLE 2.1.6.-3 (Continued)

PA-DER WQN NO.	STREAM	COWAMP SUB BASIN	LOCATION	EPA/USGS NO.
	OHIO RIVER BASIN			
(b)	Ohio River	20G	S. Heights, Beaver Co.	
(b)	Beaver River	20B	Beaver Falls, Beaver Co.	
901	Ohio River	20D	East Liverpool, Ohio	1096.50
902	Ohio River	20G	Sewickley, Allegheny Co.	860
903	Raccoon Creek	20D	Center Twp., Beaver Co.	1080
904	Beaver River	20B	Rochester, Beaver Co.	1076.15
905(a)	Beaver River	20B	Eastvalle, Beaver Co.	1075
906	Beaver River	20B	Wampum, Lawrence Co.	1055
907	Connoquenessing Creek	20C	Franklin Twp., Beaver Co.	1060
908	Slippery Rock Creek	20C	Perry Twp., Lawrence Co.	1065
909	Shenango River	20A	New Castle, Lawrence Co.	1045
910	Shenango River	20A	Sharpsville, Mercer Co.	1035
912(c)	Pymatuning Creek	20A	So. Pymatuning Twp., Mercer Co.	1025
913	L. Shenango River	20A	Hempfield Twp., Mercer Co.	
914	Chartiers Creek	20F	Carnegie, Allegheny Co.	855
915	Mahoning River	20B	Mahoning Twp., Lawrence Co.	996
916	Chartiers Creek	20F	Peters Twp., Washington Co.	852.60
917	Connoquenessing Creek	20C	Penn Twp., Butler Co.	1058.10
918	Two Mile Run	20B	Borough Twp., Beaver Co.	1076.20
919(c)	Brush Creek	20C	Marion Twp., Beaver Co.	1060.18
920	Glade Run	20C	Forward Twp., Butler Co.	1058.50
921	Slippery Rock Creek	20C	Worth Twp., Butler Co.	1061.53
922	Slippery Rock Creek	20C	Perry Twp., Lawrence Co.	1065
923	N. Fork L. Beaver Creek	20B	L. Beaver Twp., Lawrence Co.	1093.90
924(c)	Big Run	20A	New Castle, Lawrence Co.	1052.48
926	Slippery Rock Creek	20C	Marion Twp., Butler Co.	1060.30

TABLE 2.1.6.-3 (Continued)

PA-DER WQN NO.	STREAM	COWAMP SUB-BASIN	LOCATION	EPA/USGS NO.
	UPPER WEST BRANCH SUSQUEHANNA BASIN (d)			
404	West Branch Susquehanna River	8D	Karthaus, Clearfield Co.	5425
405	West Branch Susquehanna River	8B	Curwensville Reservoir Dam, Clearfield Co.	5412
406	West Branch Susequehanna River	8B	Bower, Clearfield Co.	5410
422	Clearfield Greek	8C	Clearfield, Clearfield Co.	5415.50
436	Chest Creek	8B	Mahaffey, Clearfield Co.	5408.23
438	Alder Run	8C	Kylertown, Clearfield Co.	5418
440	Anderson Creek	8B	Curwensville, Clearfield Co.	5412.48

NOTES: (a) EPA Primary Station

(b) ORSANCO Station

(c) Discontinued

(d) Not in the Ohio River Watershed

Reproduced from best available copy.

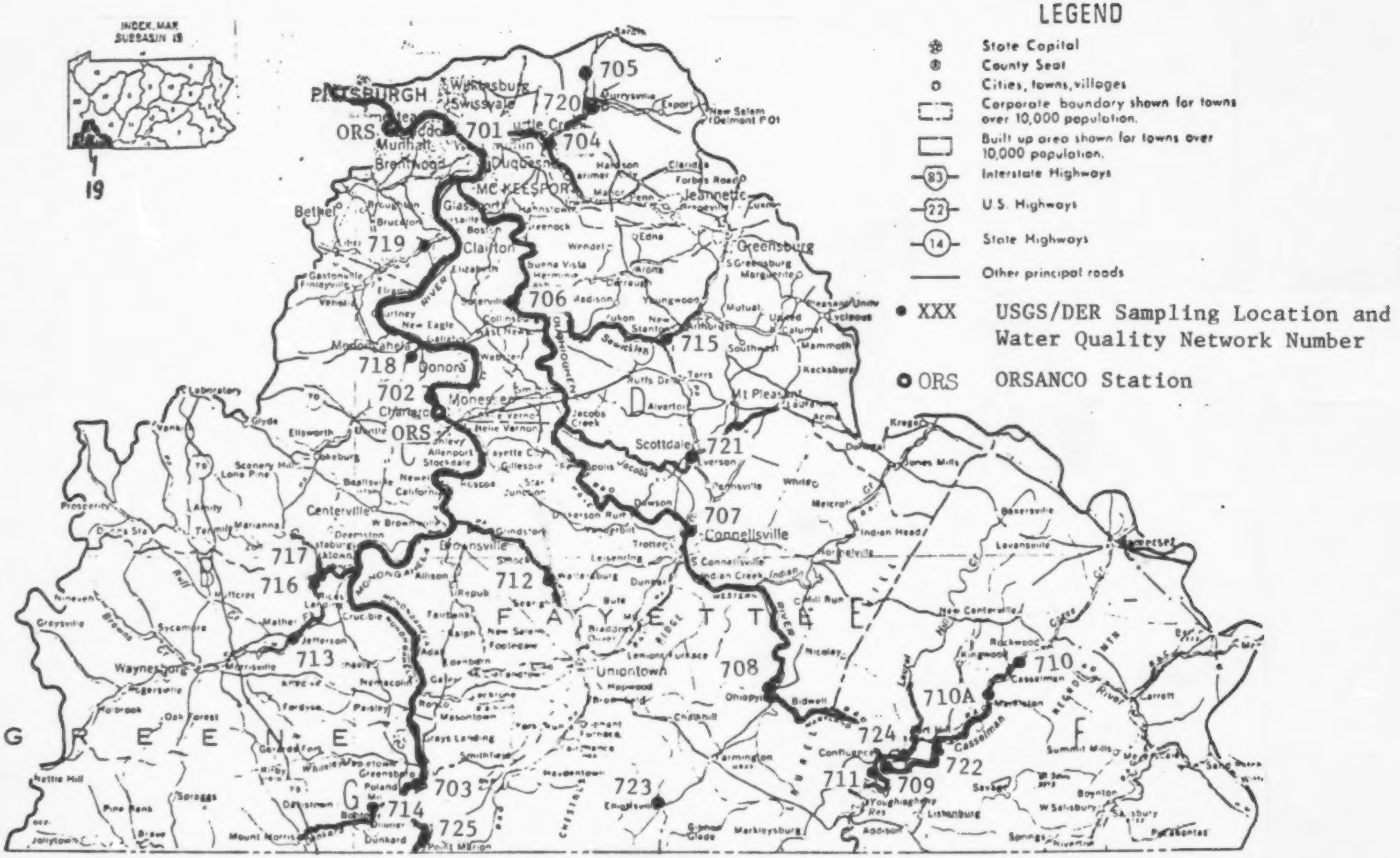

INDEX MAP SUBBASIN 19
19
LEGEND
State Capital
County Seat
Cities, towns, villages
Corporate boundary shown for towns over 10,000 population.
Built up area shown for towns over 10,000 population.
83 Interstate Highways
22 U.S. Highways
14 State Highways
Other principal roads
• XXX USGS/DER Sampling Location and Water Quality Network Number
ORS ORSANCO Station
PITTSBURGH
ORS
Munhall
Brentwood
Wilkinsburg
Swissvale
McKEESPORT
Duquesne
Clairton
Bethel
Monongahela
Donora
Charleroi
Monessen
ORS
Centerville
Brownsville
Uniontown
Connellsville
Scottdale
Greensburg
Jeannette
Mt Pleasant
Waynesburg
Somerset
701
702
703
704
705
706
707
708
709
710
710A
711
712
713
714
715
716
717
718
719
720
721
722
723
724
725
G R E E N E
F A Y E T T E
D
C
E
F
G

FIGURE 2.1.6.-3 SURFACE WATER QUALITY SAMPLING LOCATIONS -- MONONGAHELA RIVER BASIN

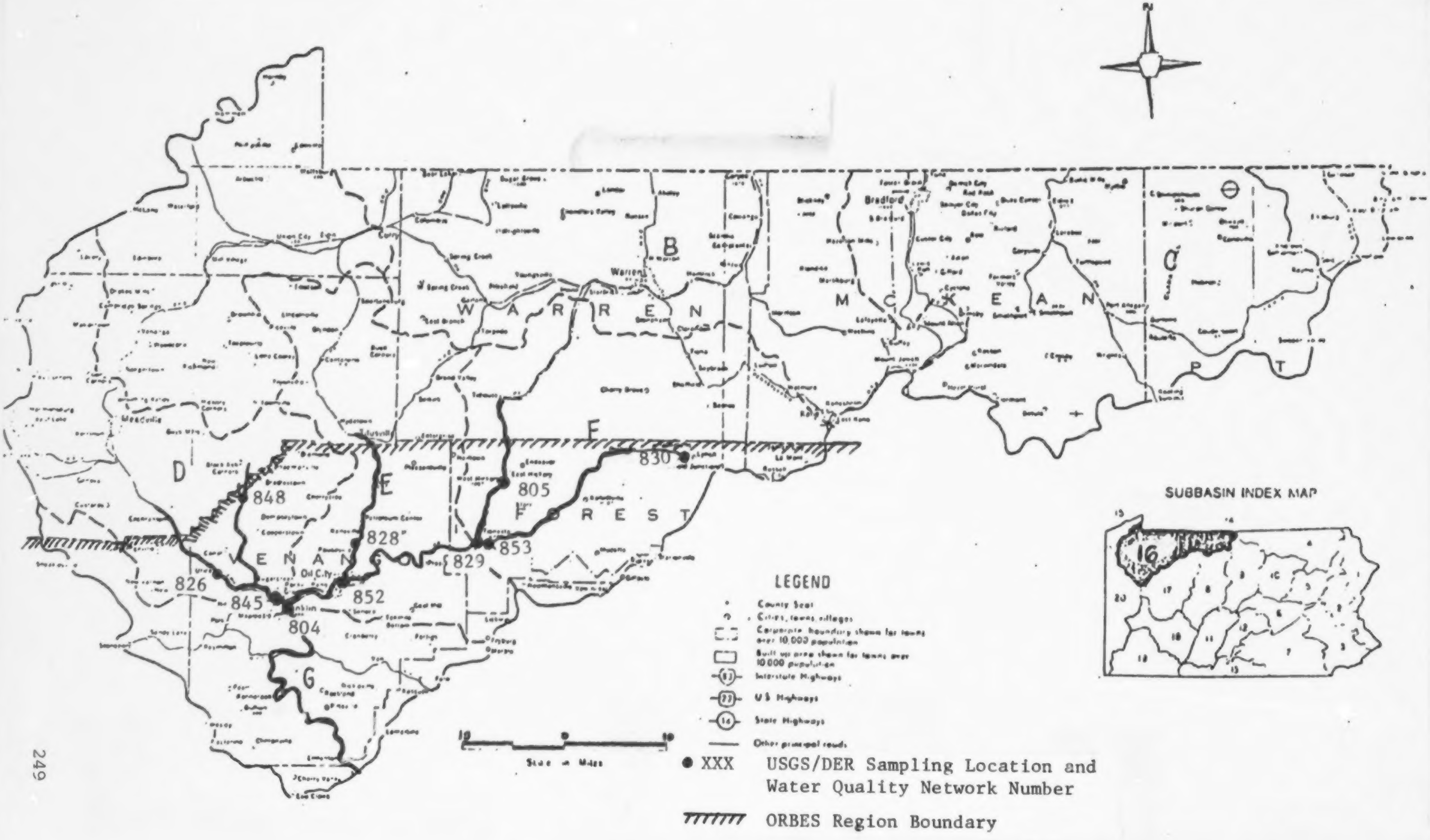
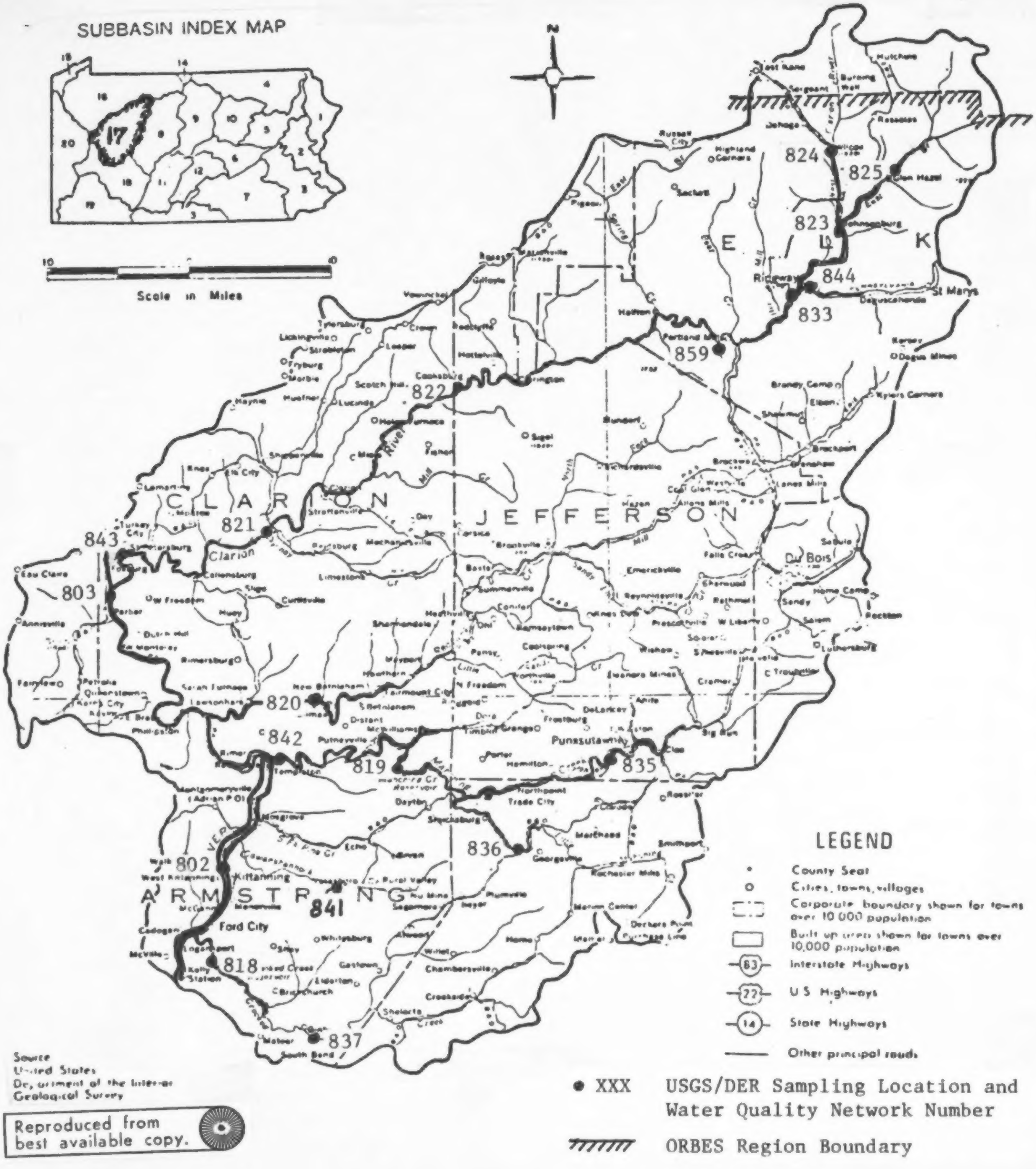

N
B
C
D
E
F
G
P T
WARREN
McKEAN
FOREST
VENANGO
830
805
853
829
828
852
848
826
845
804
Bradford
Warren
Meadville
Titusville
Oil City
Franklin
SUBBASIN INDEX MAP
16
LEGEND
County Seat
Cities, towns, villages
Corporate boundary shown for towns over 10,000 population
Built up area shown for towns over 10,000 population
Interstate Highways
U.S. Highways
State Highways
Other principal roads
Scale in Miles
10
0
10
• XXX USGS/DER Sampling Location and Water Quality Network Number
ORBES Region Boundary

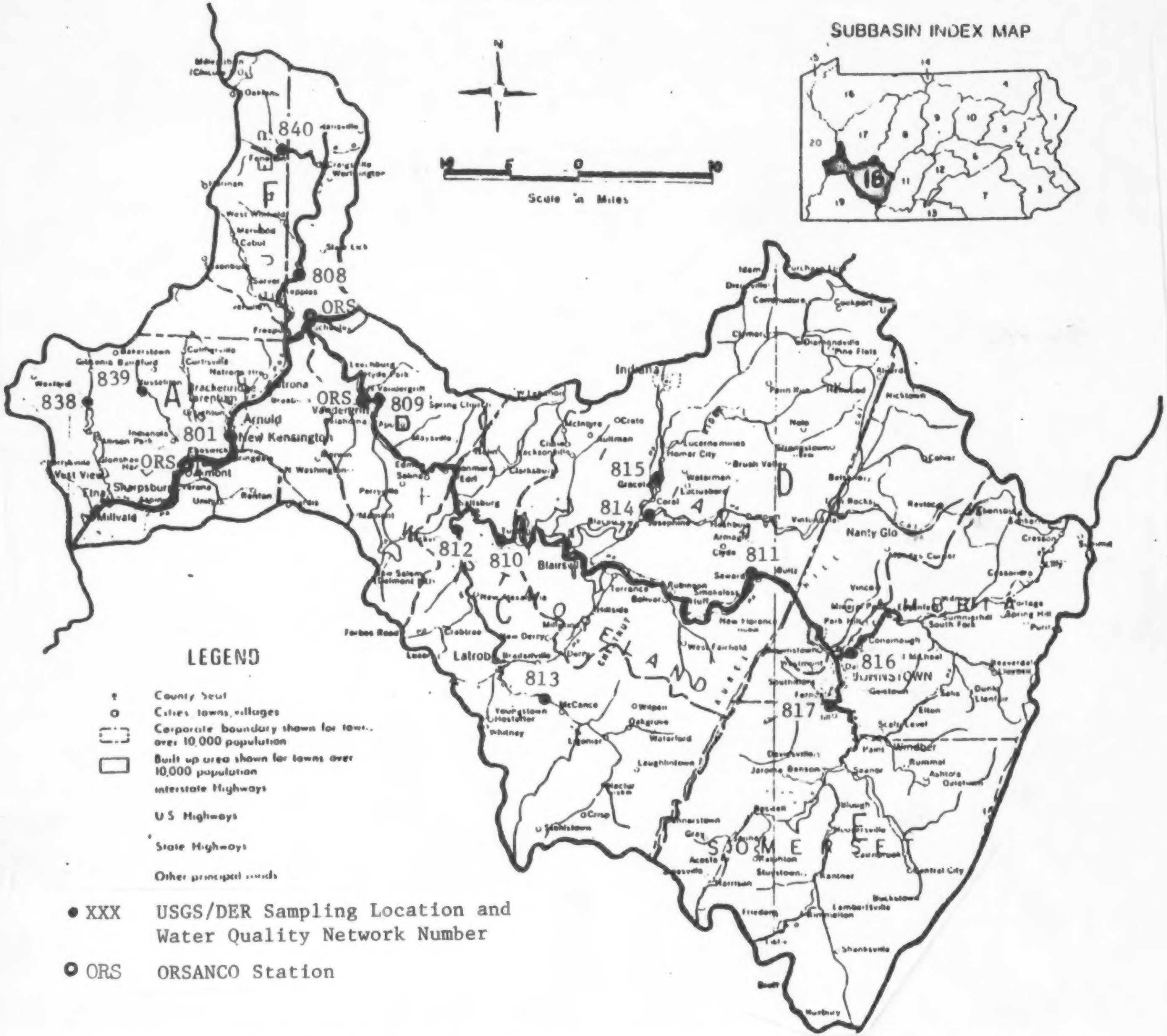
FIGURE 2.1.6-4 SURFACE WATER QUALITY SAMPLING LOCATIONS -- UPPER ALLEGHENY RIVER BASIN


SUBBASIN INDEX MAP
17
Scale in Miles
N
CLARION
JEFFERSON
ARMSTRONG
ELK
824
825
823
844
833
859
822
821
843
803
820
842
819
835
836
802
841
818
837
LEGEND
County Seat
Cities, towns, villages
Corporate boundary shown for towns over 10,000 population
Built up areas shown for towns over 10,000 population
Interstate Highways
U S Highways
State Highways
Other principal roads
● XXX USGS/DER Sampling Location and Water Quality Network Number
ORBES Region Boundary

Source
United States
Department of the Interior
Geological Survey

Reproduced from
best available copy.

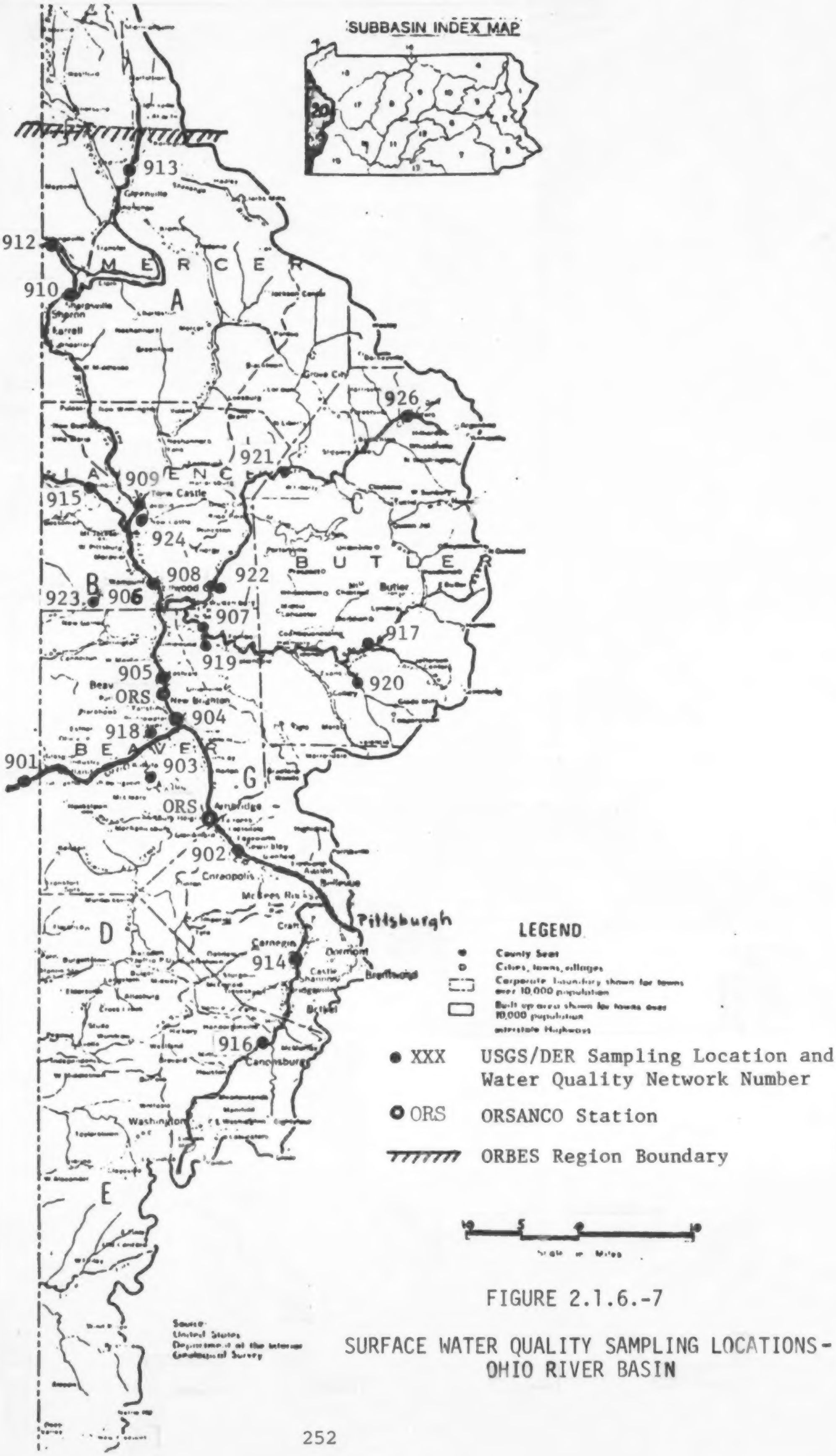
FIGURE 2.1.6.-5 SURFACE WATER QUALITY SAMPLING LOCATIONS
MIDDLE ALLEGHENY RIVER BASIN



SUBBASIN INDEX MAP
16
N
10
5
0
10
Scale in Miles
LEGEND
County Seat
Cities, towns, villages
Corporate boundary shown for towns over 10,000 population
Built up area shown for towns over 10,000 population
Interstate Highways
U S Highways
State Highways
Other principal roads
840
808
ORS
839
838
801
ORS
ORS
809
815
814
812
810
811
813
816
817
Arnold
New Kensington
Sharpsburg
Millvale
Indiana
Blairsville
Latrobe
Nanty Glo
JOHNSTOWN
A
F
D
C
W
M
B
E
S
SOMERSET
WESTMORELAND
CAMBRIA

- XXX USGS/DER Sampling Location and Water Quality Network Number
- ORS ORSANCO Station

FIGURE 2.1.6.-6 SURFACE WATER QUALITY SAMPLING LOCATIONS -- LOWER ALLEGHENY RIVER BASIN


SUBBASIN INDEX MAP
20
913
912
MERCER
910
A
926
921
909
LAWRENCE
915
C
924
BUTLER
908
922
Butler
B
923
906
907
917
919
920
905
ORS
New Brighton
918
904
BEAVER
901
903
G
ORS
Ambridge
902
Coraopolis
Pittsburgh
D
Carnegie
914
916
Canonsburg
Washington
E
LEGEND
County Seat
Cities, towns, villages
Corporate boundary shown for towns over 10,000 population
Built up area shown for towns over 10,000 population
Interstate Highways
● XXX USGS/DER Sampling Location and Water Quality Network Number
○ ORS ORSANCO Station
ORBES Region Boundary
Scale in Miles

Source: United States Department of the Interior Geological Survey

FIGURE 2.1.6.-7

SURFACE WATER QUALITY SAMPLING LOCATIONS - OHIO RIVER BASIN

2.1.6.3. WATER QUALITY CONTROL AND STANDARDS

A. Federal Control

On October 18, 1972, the Congress, over a presidential veto, enacted Public Law 92-500, the Federal Water Pollution Control Act Amendments of 1972. Responding to public demand for cleaner water, the law it enacted culminated two years of intense debate, ... and resulted in the most assertive step in the history of national water pollution control activities...
The Act, P.L. 92-500, departed in several ways from previous water pollution control legislation. It expanded the Federal role in water pollution control, increased the level of Federal funding for construction of publicly owned waste treatment works, elevated planning to a new level of significance, opened new avenues for public participation and created a regulatory mechanism requiring uniform technology-based effluent standards together with a national permit system for all point source dischargers as the means of enforcement...
The objective of the Act is to "restore and maintain the chemical physical, and biological integrity of the Nation's waters."...
The goals are:
- To reach, "wherever attainable, a water quality that provides for the protection and propagation of fish, shellfish and wildlife" and "for recreation in and on the water" by July 1, 1983.

- To eliminate the discharge of pollutants into navigable waters by 1985.

The Act provides for achieving its goals and objectives in phases, with accompanying requirements and deadlines.
Phase I, an extension of the program embodied in many state laws and Federal regulations, requires industry to install "best practicable control technology currently available (BPT); and publically owned treatment works to achieve secondary treatment -- by July 1, 1977 --- as well as "any more stringent limitations, including those to meet [state or Federal] water quality standards ..." [Sec 301(b) (1) (c)]
Phase II requirements are intended to be more vigorous and more innovative. Industries are to install "best available technology economically achievable [BAT]... which will result in reasonable further progress toward the national goal of eliminating the discharge of all pollutants"; and publicly owned treatment works are to achieve "best practicable waste treatment technology... including reclaiming and recycling of water, and confined disposal of pollutants" (BPWTT) -- by July 1, 1983 -- as well as any water quality related effluent limitation. (Sec 302) Ultimately all point source controls are directed toward achieving the national goal of the elimination of the discharge of pollutants by 1985. (8)

The National Wild and Scenic Rivers Act of 1968 (PL 90-542) declared it

> ".....to be the policy of the United States that certain selected rivers of the Nation...be preserved in free-flowing condition, and that they and their immediate environments shall be protected...."

The Act designated eight rivers as initial components of the National Wild and Scenic River System and 27 rivers for study as potential additions. None of the eight designated rivers, but the following three of the potential additions to the National System are in the PA ORBES Region.

- Allegheny River from mouth to East Brady in the middle and Lower Allegheny Basins
- Clarion River from Ridgeway to its confluence with the Allegheny River in the Middle Allegheny River Basin
- Youghiogheny River from Youghiogheny River Dam to Connellsville in the Monongahela River Basin

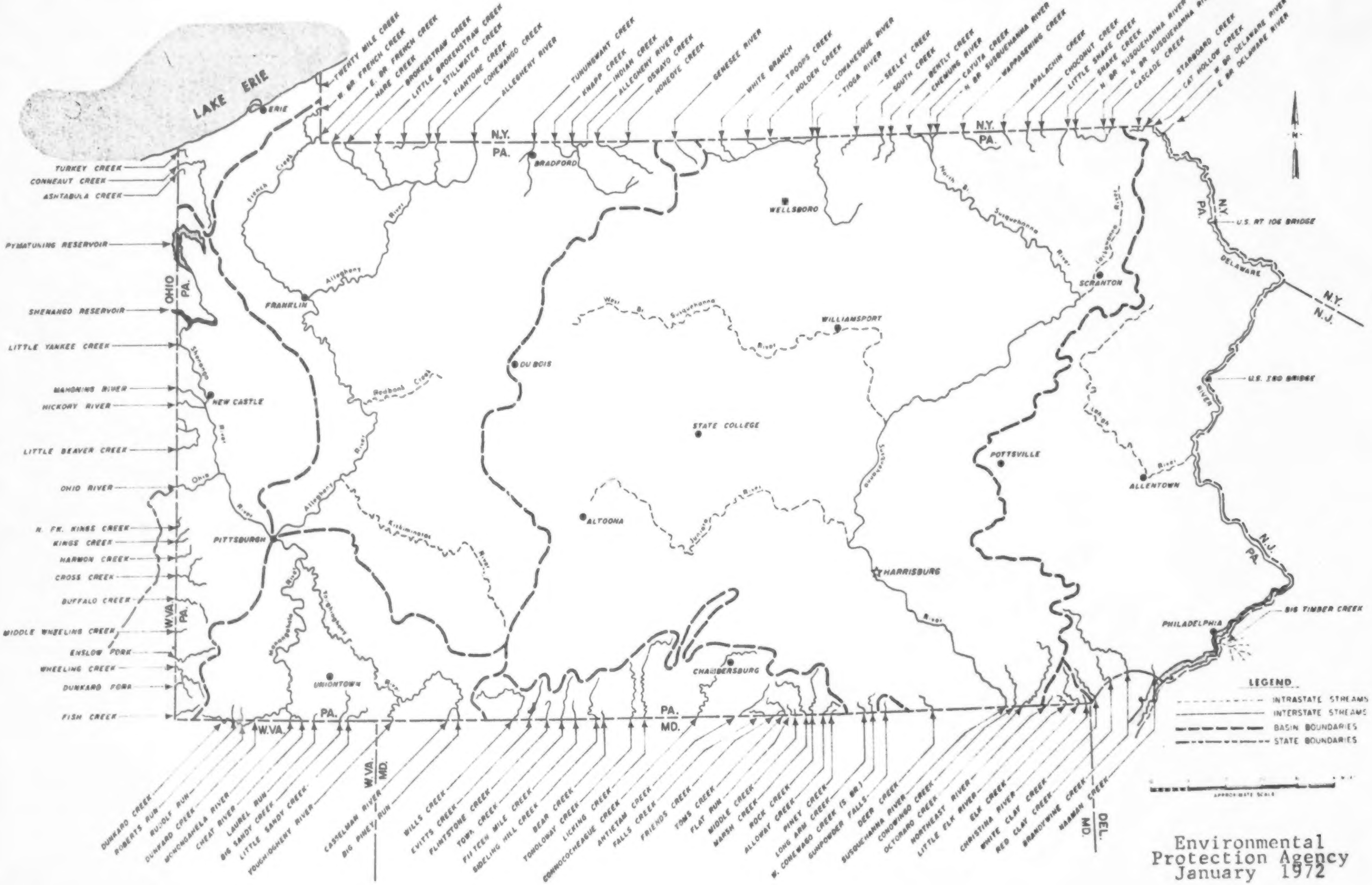
It can be expected that water pollution abatement efforts will be accelerated along these rivers in order to qualify them for inclusion. A recently completed study on the Youghiogheny River by the U.S. Department of the Interior found the river water quality sufficiently improved to support significant sport fisheries and recreation and recommended that the 27-mile segment of the Youghiogheny between Youghiogheny Dam and South Connellsville, PA., be included in the National Wild and Scenic Rivers System (9).

B. State Control

In 1965 Congress authorized the establishment of water quality standards for interstate water. The Water Quality Act of 1965 provided for the States to have the first opportunity to establish these standards for their interstate waters. Pennsylvania's standards were approved by the Secretary of the Interior in 1968 (10). Figure 2.1.6.-8 shows a map of the significant interstate

FIGURE 2.1.6.-8 SIGNIFICANT INTERSTATE WATERS OF THE COMMONWEALTH OF PENNSYLVANIA

Source (10)


LAKE ERIE
ERIE
TWENTY MILE CREEK
W. BR FRENCH CREEK
E. BR FRENCH CREEK
HARE CREEK
BROKENSTRAW CREEK
LITTLE BROKENSTRAW CREEK
STILLWATER CREEK
KIANTONE CREEK
CONEWANGO CREEK
ALLEGHENY RIVER
TUNUNGWANT CREEK
KNAPP CREEK
INDIAN CREEK
ALLEGHENY RIVER
OSWAYO CREEK
HONEOYE CREEK
GENESEE RIVER
WHITE BRANCH
TROOPS CREEK
HOLDEN CREEK
COWANESQUE RIVER
TIOGA RIVER
SEELEY CREEK
SOUTH CREEK
BENTLY CREEK
CHEMUNG RIVER
CAYUTA CREEK
N BR SUSQUEHANNA RIVER
WAPPASENING CREEK
APALACHIN CREEK
CHOCONUT CREEK
LITTLE SNAKE CREEK
SNAKE CREEK
N BR SUSQUEHANNA RIVER
N BR SUSQUEHANNA RIVER
CASCADE CREEK
STARBOARD CREEK
CAT HOLLOW CREEK
W BR DELAWARE RIVER
E BR DELAWARE RIVER
N.Y.
PA.
N
U.S. RT 106 BRIDGE
DELAWARE
N.Y.
N.J.
U.S. 380 BRIDGE
RIVER
N.J.
PA.
BIG TIMBER CREEK
PHILADELPHIA
TURKEY CREEK
CONNEAUT CREEK
ASHTABULA CREEK
PYMATUNING RESERVOIR
OHIO
PA.
SHENANGO RESERVOIR
LITTLE YANKEE CREEK
MAHONING RIVER
HICKORY RIVER
LITTLE BEAVER CREEK
OHIO RIVER
N. FK. KINGS CREEK
KINGS CREEK
HARMON CREEK
CROSS CREEK
BUFFALO CREEK
W.VA.
PA.
MIDDLE WHEELING CREEK
ENSLOW FORK
WHEELING CREEK
DUNKARD FORK
FISH CREEK
BRADFORD
WELLSBORO
FRANKLIN
DU BOIS
WILLIAMSPORT
SCRANTON
NEW CASTLE
STATE COLLEGE
POTTSVILLE
ALLENTOWN
ALTOONA
PITTSBURGH
HARRISBURG
UNIONTOWN
CHAMBERSBURG
French Creek
Allegheny River
Redbank Creek
Shenango River
Ohio River
Allegheny River
Kiskiminetas River
Monongahela River
Youghiogheny River
West Br. Susquehanna River
Juniata River
Susquehanna River
North Br. Susquehanna River
Lackawanna River
Lehigh River
PA.
W.VA.
W.VA.
MD.
PA.
MD.
DEL.
MD.
DUNKARD CREEK
ROBERTS RUN
RUDOLF RUN
DUNFARD CREEK
MONONGAHELA RIVER
CHEAT RIVER
LAUREL RUN
BIG SANDY CREEK
LITTLE SANDY CREEK
YOUGHIOGHENY RIVER
CASSELMAN RIVER
BIG PINEY RUN
WILLS CREEK
EVITTS CREEK
FLINTSTONE CREEK
TOWN CREEK
FIFTEEN MILE CREEK
SIDELING HILL CREEK
BEAR CREEK
TONOLOWAY CREEK
LICKING CREEK
CONNOCOCHEAGUE CREEK
ANTIETAM CREEK
FALLS CREEK
FRIENDS CREEK
TOMS CREEK
FLAT RUN
MIDDLE CREEK
MARSH CREEK
ROCK CREEK
ALLOWAY CREEK
PINEY CREEK
LONG ARM CREEK
W. CONEWAGO CREEK (S BR.)
GUNPOWDER FALLS
DEER CREEK
SUSQUEHANNA RIVER
CONOWINGO CREEK
OCTORARO CREEK
NORTHEAST RIVER
LITTLE ELK RIVER
ELK CREEK
CHRISTINA RIVER
WHITE CLAY CREEK
RED CLAY CREEK
BRANDYWINE CREEK
NAAMAN CREEK
LEGEND
INTRASTATE STREAMS
INTERSTATE STREAMS
BASIN BOUNDARIES
STATE BOUNDARIES
APPROXIMATE SCALE

Environmental
Protection Agency
January 1972

waters to which the standards apply. The ORBES counties include interstate streams from the Casselman River on the Maryland border - to the Allegheny River on the New York border.

Control over internal waters has been under the active jurisdiction of the Pennsylvania State government since 1923. In 1937 "The Clean Streams Law" of Pennsylvania was passed which provided for the preservation and improvement of State streams. A recent issue of the "Pennsylvania Bulletin"(11) relates some of the new changes in the State Law, and outlines the history of control over Pennsylvania's water quality:

> Water quality standards are an important element of the State's water quality management program in that they set general and specific goals for the quality of our streams. Some type of water quality standard has been in use for more than 50 years in Pennsylvania. One of the Sanitary Water Board's early action after its creation in 1923 was to classify streams as to priority for water quality management actions. In 1947 the Sanitary Water Board classified all streams in the state as to the degree of treatment that had to be provided before discharge.
> During the period 1966 through 1973, specific water quality standards were developed by the Department of Environmental Resources for all Pennsylvania surface waters. These water quality standards had three major parts: (1) a listing of water uses to be protected; (2) general water quality criteria and specific water quality criteria; and (3) a plan of implementation describing the effluent limits necessary for point source discharges to meet the water quality criteria.
> After a series of public hearings, the water uses and water quality criteria for Pennsylvania streams were incorporated into Chapter 93 of the Department's Rules and Regulations. The implementation plans were not adopted as regulations. The implementation plans served as the basis for notices and orders to upgrade wastewater treatment that were issued to manicipalities and industries. Since 1973, they have also been used as the basis for certifying effluent limits in federal wastewater discharge permits (NPDES). Public Law 92-500, which amended the Federal Water Pollution Control Act, has changed the make up of the old water quality standards by eliminating the implementation plan as a part of the standard. Implementation has now been made a part of the areawide water quality management planning process and the NPDES permit process in the federal program. The new water quality standards can, however, affect waste sources since the Department must take action to insure that the water quality standards (instream) are met. The standards are to be used as program objectives in the control of both point and non-point sources of pollution. (11)

Figure 2.1.6.-9 shows a map of the internal waters of Pennsylvania to which the State standards apply. The major drainage areas and tributaries within the PA-ORBES Region are listed in Table 2.1.6.-4.

Pennsylvania also has control over the degradation of high quality waters in the State. The policy was approved by the Environmental Protection Agency in 1971 and is enforceable under both Pennsylvania and Federal law (10). The new wording of this policy in the proposed revisions for 1978 wastewater treatment requirements (Chapter 95) states that:

> ...waters having a water use designated as "High Quality Waters"... shall be maintained... at their existing quality, unless... the proposed... discharge... of pollutants is justified as a result of necessary economic or social development which is of significant public value. (11)

In the existing regulations governing high quality waters they are called "Conservation Areas" and fall under the heading of "Recreation" (Chapter 93, (12)). A list of the existing Conservation Area Watersheds in the ORBES counties is presented in Table 2.1.6.-5. However, the concept has been expanded in the 1978 proposed revisions and high quality waters have become a water use in their own right, independent of recreational use (Chapter 93, (11)). Most of watersheds presently classified as "Conservation Area" streams are proposed to be renamed "High Quality Waters" or "Exceptional Value Waters" under the general title "Special Protection".

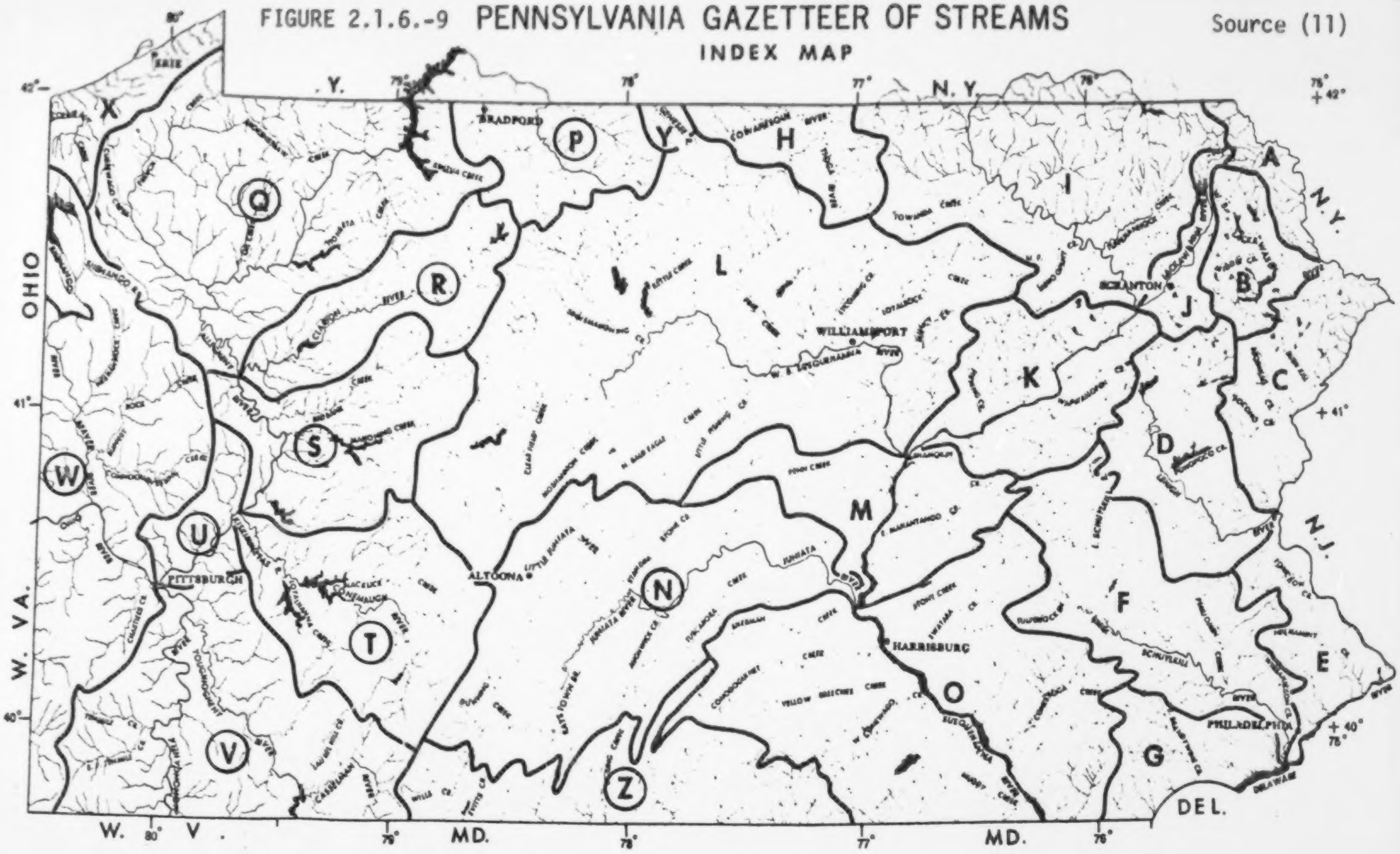
Pennsylvania's Scenic Rivers Act (Act. No. 283, December 1972) authorized the establishment of the Pennsylvania Scenic River System. The Act established four classifications into which streams could be assigned: (27)

Class 1 Wild river areas - those rivers or sections of rivers that are free of impoundments and generally inaccessible except by trail, with watersheds or shorelines essentially primitive and waters unpolluted.

Class 2 Scenic river areas - those rivers or sections of rivers that are free of impoundments, with shorelines or watersheds still largely primitive and undeveloped, but accessible in places by roads.

FIGURE 2.1.6.-9 PENNSYLVANIA GAZETTEER OF STREAMS INDEX MAP

Source (11)



N.Y.
N.Y.
N.Y.
OHIO
W. VA.
W. V.
MD.
MD.
DEL.
N.J.
42°
41°
40°
80°
79°
78°
77°
76°
75°
ERIE
BRADFORD
SCRANTON
WILLIAMSPORT
ALTOONA
PITTSBURGH
HARRISBURG
PHILADELPHIA
A
B
C
D
E
F
G
H
I
J
K
L
M
N
O
P
Q
R
S
T
U
V
W
X
Y
Z
CONEWANGO CREEK
TOWANDA CREEK
LOYALSOCK CREEK
PINE CREEK
JUNIATA RIVER
SUSQUEHANNA RIVER
SCHUYLKILL RIVER
CONOCOCHEAGUE CREEK
YELLOW BREECHES CREEK
YOUGHIOGHENY RIVER
TIOGA RIVER
BEAVER RIVER
DELAWARE

TABLE 2.1.6.-4

MAJOR DRAINAGE AREAS AND TRIBUTARIES IN THE PA ORBES REGION

RIVER	DRAINAGE AREA (See Fig. 2.1.6.-9)	TRIBUTARY	TRIBUTARY
Allegheny	Q	Tionesta Creek	
		Oil Creek	
		French Creek	Sugar Creek
		Sandy Creek	
	R	Clarion River	Spring Creek
			Toby Creek
	S	Bear Creek	
		Redbank Creek	Sandy Lick Creek
		Mahoning Creek	Little Mahoning Creek
		Cowanshannock Cr.	
		Crooked Creek	
	T	Kiskiminetas River	Conemaugh River
			Stony Creek
			Two Lick Creek
			Loyalhanna Creek
	U	Buffalo Creek	
		Deer Creek	
		Plum Creek	
		Pine Creek	
Monongahela	V	Cheat River	
		Dunkard Creek	
		Georges Creek	
		Whiteley Creek	
		Tenmile Creek	South Fork Tenmile Creek
		Dunlap Creek	
		Redstone Creek	
		Peters Creek	
		Youghiogheny River	Casselman River
			Laurel Hill Creek
			Indian Creek
			Jacobs Creek
			Sewickley Creek
		Turtle Creek	Abers Creek
Ohio	W	Chartiers Creek	
		Beaver River	Mahoning River
			Shenango River
			Connoquenessing Creek
			Slippery Rock Creek
		Raccoon Creek	
West Branch Susquehanna (Not in the Ohio River Watershed)	L	Chest Creek	
		Anderson Creek	
		Clearfield Creek	
		Moshannon Creek	
		Bennett Branch - Sinnemahoning Cr.	
Susquehanna (Not in the Ohio River Watershed)	N	Raystown Branch - Juniata River	
Potomac River (Not in the Ohio River Watershed)	Z	Wills Creek	

TABLE 2.1.6.-5

CONSERVATION AREA WATERSHEDS IN ORBES COUNTIES IN PENNSYLVANIA

After Source (11)

Allegheny County - None

Armstrong County

- Buffalo Creek and tributaries from the source to and including Little Buffalo Creek (see also Butler County)

- Pine Creek watershed

Beaver County - None

Butler County

- Buffalo Creek and tributaries from the source to and including Little Buffalo Creek (see also Armstrong County)

Clarion County

- Turkey Run
- Beaver Creek
- "Upper" Mill Creek (Also Jefferson County)
- Blyson Run
- Maxwell Run
- Cather Run (Also Jefferson County)

Cambria County

- West Branch of the Susquehanna River Basin
  1. Chest Creek Basin, source to municipal water supply intake in Patton Borough

- Conemaugh River Basin
  1. Saltlick Run Basin
  2. South Fork Little Conemaugh River Basin from and including Beaverdam Run to source
  3. Bens Creek Basin
  4. Noels Creek Basin
  5. Laurel Run Basin

Clearfield County

- West Branch Susquehanna River Tributaries
  1. Trout Run Basin
  2. Lick Run Basin
  3. Moose Creek Basin from Moose Creek Dam to source
  4. Montgomery Creek Basin from Montgomery Dam to source
  5. Anderson Creek Basin from DuBois Dam to source
  6. South Branch Basin of Bennett Branch

- Redbank Creek basin
  1. Wolf Run Basin

- Mahoning Creek basin
  1. East Branch Mahoning Creek Basin from source to but not including Beaver Run
  2. Clover Run Basin

Elk County

- Sinnemahoning Creek Basin
  1. Mix Run Basin - Bennett Branch
  2. Hicks Run Basin - Bennett Branch
  3. Medix Run Basin - Bennett Branch
  3. Laurel Run Basin - Bennett Branch
- Spring Creek (Also Forest County)
- Crow Run
- Bear Creek
- Big Mill Creek
- Little Mill Creek
- Silver Creek
- Wolf Run
- E. Br. Clarion
- S. Br. Tionesta Creek
- Millstone Creek (Also Jefferson County)
- Wyncoop Run
- Maxwell Run (Also Jefferson County)

Fayette County

- Dunbar Creek and tributaries from its source to and including Elk Rock Run
- Morgan Run watershed
- Tributaries of Big Sandy Creek

Forest County

- Tubbs Run
- L. Hickory Run
- E. Hickory Creek
- L. Coon Creek
- Ross Run
- Bear Creek
- Salmon Creek
- Fork Run
- Bobbs Creek
- Blood Run
- Minister Creek
- Fools Creek
- Lower Sheriff Run
- Upper Sheriff Run
- Blue Jay Creek
- Troutman Run
- Coleman Run
- Maple Creek
- Cherry Run

Greene County - None

Indiana County

- Little Yellow Creek watershed
- South Branch of Two Lick Creek watershed
- Richards Run watershed
- South Branch of Plum Creek watershed from source to, but not including, Reddens Run

Jefferson County

- Callen Run
- Clear Creek
- Sugarcamp Run (Also Indiana County)
- Clover Run
- N. Fk. Redbank Creek
- L. Mill Creek
- Schoolhouse Run
- Falls Creek

Somerset County

- Potomac River Basin
  1. The basins of Wills Creek tributaries from source to Pennsylvania-North Branch Jennings Run and Gooseberry Run Basins

- Youghiogheny River Basin
  1. Laurel Hill Creek Basin

- Conemaugh River Basin
  1. North Fork Bens Creek Basin
  2. South Fork Bens Creek Basin
  3. Bobcock Creek Basin
  4. Clear Shade Creek Basin
  5. Roaring Run Basin
  6. Beaverdam Creek Basin (Tributary of Quemahoning Creek)
  7. Spruce Run Basin
  8. Beaverdam Creek Basin (Tributary of Stony Creek)

Washington County - None

Westmoreland County

- Loyalhanna Creek watershed from source to and including Laughlintown Run
- Serviceberry Run watershed
- Indian Camp Run watershed
- Coalpit Run watershed
- South Fork of Mill Creek watershed
- North Fork of Mill Creek watershed
- Shirey Run watershed
- Tubmill Run watershed above Tubmill reservoir
- Shannon Run watershed
- Baldwin Creek watershed

Class 3 Recreational rivers - those rivers or sections of rivers that are readily accessible, that may have some development along their shorelines and may have undergone some impoundment or diversion in the past.

Class 4 Modified recreational rivers - those rivers or sections of rivers in which the flow may be regulated by control devices located upstream. Low dams are permitted in the reach so long as they do not increase the river beyond bank-full width. These reaches are used for human activities which do not substantially interfere with public use of the streams or the enjoyment of their surroundings.

The Department of Environmental Resources published a list of potential candidate streams for inclusion in this protected river system (13). The streams selected from the ORBES Region are listed in Table 2.1.6.-6. As can be seen in the Table, the candidate streams were categorized according to their relative area-wide significance (first, second, and third priorities) and the First Priority streams were further subdivided into three priority subgroups (A, B, and C) based upon the urgency of protective action.

It can be expected that several years will pass before detailed studies on the candidate streams will be completed and any one of them will be legally designated a Pennsylvania Scenic River with mandated restrictions on development in the designated segment. However, in the meantime, the nomination can be regarded as an environmental constraint where special emphasis will be placed on the examination of all related activity. Currently, (mid-1978) DER is in the process of completing detailed studies of French Creek and Dunbar Creek in the ORBES Region for possible nomination.

C. Water Quality Standards

Water Quality standards are contained in Chapter 93 of the "Rules and Regulations"(12) published by the Department of Environmental Resources. Confusion over the meaning of the words "criteria" and "standards" was generated by their use in the 1965 amendments to the Federal Water Pollution Control Act. The Department of Environmental Resources (State) has recently

TABLE 2.1.6.-6 PROPOSED PENNSYLVANIA SCENIC RIVERS IN THE ORBES REGION

Sources (13) & (27)

Drainage Area(a)	Stream Name	Location (County)	Segment Limits	Class (b)	Priority Group(c)
Q	Tionesta Creek	Forest, McKean, Warren(d)	Headwaters to Tionesta Reservoir	S	1A
	Lake Creek	Crawford, Venango(d)	Headwaters to Sugar Creek	R	1A
	Sugar Creek	Venango	Junction of Brandies to French Creek	MR	1A
	French Creek	Crawford, Mercer, Venango(d)	Headwaters to Allegheny River	MR	1A
	Allegheny River	Warren, Forest, Venango, Clarion(d)	Kinzua Dam to Clarion River	S, R, MR	1A
	Oil Creek	Crawford, Venango(d)	Titusville to Rouseville	S	1B
	Pithole Creek	Forest, Venango	Headwaters to Allegheny River	S	2
	East Sandy Creek	Clarion, Venango	Headwaters to Allegheny River	R	2
	Sandy Creek	Mercer, Venango	Sandy Lake to Allegheny River	R	2
	Little Scrubgrass Creek	Butler, Venango	Headwaters to Allegheny River	S	2
R	Clarion River	Clarion, Elk, Forest, Jefferson	Ridgeway to Allegheny River	S	1A
	Bear Creek	Elk	Headwaters to Clarion River	S	1B

TABLE 2.1.6.-6 Continued

Drainage Area(a)	Stream Name	Location (County)	Segment Limits	Class (b)	Priority Group(c)
S	North Fork, Redbank Creek	Jefferson	Headwaters to Redbank Creek	W, S	1A
	Allegheny River	Clarion	Clarion River to East Brady	S	1A
	Allegheny River	Armstrong	East Brady to Kiskiminetas River	S, MR	1C
	Redbank Creek	Armstrong, Clarion	S. Bethlehem to Allegheny River	S	2
	Mahoning Creek	Armstrong	Mahoning Creek Lake to Allegheny River	R	3
	Cowanshannock Creek	Armstrong	Junction of Branches to Allegheny River	S	3
T	Clear Shade Creek	Somerset	Headwaters to Shade Creek	S	2
	Shade Creek	Somerset	Clear Shade Creek to Stone Creek	S	2
	Loyalhanna Creek	Westmoreland	Ligonier to Conemaugh River	MR	2
	Stony Creek	Somerset	Headwaters to Paint Creek	S	3
	Blacklick Creek	Indiana	Cambria/Indiana County to Conemaugh River	R	3
	Conemaugh River	Indiana, Westmoreland	Cambria/Westmoreland County to Kiskiminetas River	R	3
U	Squaw Run	Allegheny	Headwaters to Allegheny River	S	1A
	Buffalo Creek	Armstrong, Butler	Worthington to Allegheny River	S	1B
	Allegheny River	Allegheny, Westmoreland	Kiskiminetas River to Pittsburgh	MR	1C

TABLE 2.1.6.-6 Continued

Drainage Area(a)	Stream Name	Location (County)	Segment Limits	Class (b)	Priority Group(c)
U (Cont.)	Crouse Run	Allegheny	Headwaters to Pine Creek	S	3
V	Laurel Hill Creek	Somerset	Headwaters to Casselman River	S	1A
	Casselman River	Somerset	Garrett to Youghiogheny River	S	1A
	Meadow Run	Fayette	Headwaters to Youghiogheny River	R	1A
	Cucumber Run	Fayette	Headwaters to Youghiogheny River	S	1A
	Jonathan Run	Fayette	Headwaters to Youghiogheny River	W	1A
	Indian Creek	Fayette	Mill Run Reservoir to Youghiogheny River	R	1A
	Dunbar Creek	Fayette	Headwaters to Dunbar	W	1A
	Youghiogheny River	Somerset, Fayette	Confluence, Pa. to South Connellsville	S	1A
	Youghiogheny River	Fayette, Westmoreland	South Connellsville to West Newton	S	1B
	Youghiogheny River	Westmoreland, Allegheny	West Newton to Versailles	R	1C
	Mill Run	Fayette	Headwaters to Quebec Run	W	2
	Quebec Run	Fayette	Headwaters to W. Va. border	W	2
	Tenmile Creek	Greene, Washington	Daniel Run to Monongehela River	R	2
	Jacobs Creek	Fayette, Westmoreland	Headwaters to Youghiogheny River	S	3

TABLE 2.1.6.-6 Continued

Drainage Area(a)	Stream Name	Location (County)	Segment Limits	Class (b)	Priority Group(c)
V (Cont.)	Brush Creek	Westmoreland	Brush Run to Turtle Creek	MR	3
	Monongahela River	Greene, Fayette, Washington, Westmoreland, Allegheny	Point Marion to Pittsburgh	MR	3
W	Wolf Creek	Butler, Mercer	Headwaters to Slippery Rock Creek	S	1A
	Slippery Rock Creek	Butler, Lawrence	Headwaters to Connoquenessing Creek	MR, S	1A
	Connoquenessing Creek	Lawrence	Slippery Rock Creek to Beaver River	R	1A
	Dutch Fork-Buffalo Creek	Washington	Headwaters to Buffalo Creek	S	1B
	Buffalo Creek	Washington	Acheson to W. Va. Border	S	1B
	Enlow Fork-Wheeling Creek	Greene	Headwaters to W. Va. Border	S	1B
	Dunkard Fork-Wheeling Creek	Greene	Ryerson Station to W. Va. Border	S	1B
	Connoquenessing Creek	Beaver, Butler, Lawrence	Headwaters to Slippery Rock Cr.	R	1C
	N. Fork-Little Beaver Creek	Beaver, Lawrence	Beaver/Lawrence County, Ohio Border	R	1C
	Aunt Clara Fork-Kings Creek	Washington	Headwaters to Kings Creek	S	1C
	Little Sewickley Creek	Allegheny	Headwaters to Ohio River	S	2
	Hickory Run	Lawrence	Bessemer to Mahoning River	S	2
	Neshannock Creek	Lawrence	Volant to Shenango River	S	2

TABLE 2.1.6.-8

PROPOSED WATER QUALITY STANDARDS AS OF MARCH 1978:
PROTECTED WATER USES

Source (11)

§ 93.3. Protected water uses.

Water uses which shall be protected and upon which the development of water quality criteria shall be based are set forth, accompanied by their identifying symbols, in the following Table 1:

TABLE 1

Symbol	*Protected Use*
	Aquatic Life
CWF	*Cold Water Fishes* — Maintenance and/or propagation of fish species including the family Salmonidae and additional flora and fauna which are indigenous to a cold water habitat.
WWF	*Warm Water Fishes* — Maintenance and propagation of fish species and additional flora and fauna which are indigenous to a warm water habitat.
MF	*Migratory Fishes* — Passage, maintenance and propagation of anadromous and catadromous fishes and other fishes which ascend to flowing waters to complete their life cycle.
TSF	*Trout Stocking* — Maintenance of stocked trout from February 15 to July 31 and maintenance and propagation of fish species and additional flora and fauna which are indigenous to a warm water habitat.
	Water Supply
PWS	*Potable Water Supply* — Use by humans after conventional treatment for drinking, culinary, and other purposes, such as inclusion into foods (either directly or indirectly).
IWS	*Industrial Water Supply* — Use by industry for inclusion into non-food products, processing and cooling.
LWS	*Livestock Water Supply* — Use by livestock and poultry for drinking and cleansing.
AWS	*Wildlife Water Supply* — Use for waterfowl habitat and for drinking and cleansing by wildlife.
IRS	*Irrigation* — Used to supplement precipitation for growing crops.
	Recreation
B	*Boating* — Use of the water for power boating, sail boating, canoeing, and rowing for recreational purposes when surface water flow or impoundment conditions allow.
F	*Fishing* — Use of the water for the legal taking of fish.
WC	*Water Contact Sports* — Use of the water for swimming and related activities.
E	*Esthetics* — Use of the water as an esthetic setting to recreational pursuits.
	Special Protection
HQ	*High Quality Waters* — A stream or watershed which has excellent quality waters and environmental or other features that require special water quality protection.
EV	*Exceptional Value Waters* — A stream or watershed which constitutes an outstanding national, state, regional or local resource, such as waters of National, State or County parks or forests, or waters which are used or are projected for use as a source of water supply, or waters of wildlife refuges or State game lands, or waters which have been characterized by the Pennsylvania Fish Commission as "Wilderness Trout Streams," and other waters of substantial recreational or ecological significance.
	Other
N	*Navigation* — Use of the water for the commercial transfer and transport of persons, animals and goods.
TWA	*Treated Waste Assimilation* — Use of the water for assimilation and transport of treated wastewaters.

TABLE 2.1.6.-9

PROPOSED WATER QUALITY STANDARDS AS OF MARCH 1978: WATER QUALITY CRITERIA APPLICATIONS

Source (11)

§ 93.5. Application of water quality criteria to discharge of pollutants.

(a) The water quality criteria prescribed in this chapter for the various designated uses of the waters of this Commonwealth apply to receiving waters and are not to be necessarily deemed to constitute the effluent limit for a particular discharge, but, rather, are one of the major factors to be considered in developing specific limitations on the discharge of pollutants.

(b) The accepted design stream flow to which the water quality criteria as set forth in this chapter shall apply is the actual or estimated lowest seven-consecutive-day average flow that occurs once in ten years for a stream with unregulated flow or the estimated minimum flow for a stream with regulated flows, except where the Department determines that a more restrictive application is necessary to protect a particular designated or existing use. Where the lowest seven-consecutive-day average flow that occurs once in ten years is 0, the Department will specify the design flow conditions on a case-by-case basis.

(c) Where adopted water quality criteria as set forth in § 93.9 of this title (relating to designated water uses and water quality criteria) are more stringent than natural or ambient stream concentrations of specific water quality indicators, such natural or ambient stream concentrations shall be deemed to be the applicable criteria used to establish specific effluent limits.

§ 93.6. General water quality criteria.

(a) Water shall not contain substances attributable to point or non-point source waste discharges in concentration or amounts sufficient to be inimical or harmful to the water uses to be protected or to human, animal, plant, or aquatic life.

(b) Specific substances to be controlled shall include, but shall not be limited to, floating debris; oil; grease; scum and other floating materials; toxic substances; pesticides; chlorinated hydrocarbons; carcinogenic; mutagenic; and teratogenic materials; and substances which produce color, tastes, odors, or turbidity or which settle to form deposits.

§ 93.7. Specific water quality criteria.

(a) Waters of this Commonwealth for which specific criteria have been established are listed in § 93.9 of this chapter (relating to designated water uses and water quality criteria).

(b) References to specific criteria shall be keyed to use the list of specific criteria set forth in subsection (c) of this section and to groups of criteria set forth in subsection (d) of this section.

(c) The following Table 3 shall display the specific water quality criteria:

See TABLE 2.1.6.-10

(d) Unless otherwise specified in subsection (e) of this section and § 93.9 of this title (relating to designated water uses and water quality criteria), State-wide specific criteria set forth in the following Table 4 shall apply to all surface waters of this Commonwealth:

TABLE 4

Symbol	*Specific Water Quality Criteria*
Al	Aluminum
Alk$_1$	Alkalinity$_1$
As	Arsenic
Bac$_1$	Bacteria$_1$
Cr	Chromium
Cu	Copper
CN	Cyanide
F	Fluoride
Fe	Iron
Pb	Lead
Mn	Manganese
Ni	Nickel
N	Nitrite plus Nitrate
pH$_1$	pH$_1$
Phen$_1$	Phenol$_1$
TDS,	Total Dissolved Solids$_1$
Sul	Sulfate
Zn	Zinc

TABLE 2.1.6.-9 (Continued)

(e) The following Table 5 contains groups of specific water quality criteria based upon water uses to be protected. When the symbols listed below appear in the Water Uses Protected column in § 93.9 of this title (relating to designated water uses and water quality criteria), they have the meaning listed in the table below. Exceptions to these standardized groupings will be indicated on a stream-by-stream or segment-by-segment basis by the words "Add" or "Delete" followed by the appropriate symbols described in subsection (c) — Table 3 of this section.

TABLE 5

Symbol	*Water Uses Included*	*Specific Criteria*
WWF	State-wide list	State-wide list plus DO_2 and $Temp_2$
CWF	State-wide list plus cold water fish	State-wide list plus DO_1 and $Temp_1$
TSF	State-wide list plus trout stocking	State-wide list plus DO_3 and $Temp_3$
HQ-WWF	State-wide list plus high quality waters minus treated waste assimilation	State-wide list plus DO_1 and $Temp_2$
HQ-CWF	State-wide list plus high quality water and cold water fish; minus treated waste assimilation	State-wide list plus DO_6 and $Temp_1$
HQ-TSF	State-wide list plus high quality water and trout stocking; minus treated waste assimilation	State-wide list plus DO_1 and $Temp_3$
EV	State-wide list plus exceptional value water; minus treated waste assimilation	Existing quality

(f) The list of specific water quality criteria does not include all possible substances that could cause pollution. For substances not listed, the general criterion that these substances shall not be inimical or injurious to the designated water uses applies. The best scientific information available will be used to adjudge the suitability of a given waste discharge where these substances are involved.

§ 93.8. Development of specific water quality criteria for the protection of aquatic life.

(a) When a specific water quality criterion has not been established for a pollutant in § 93.7 (c) — Table 3 or (f) of this title (relating to specific water quality criteria) and a discharge of pollutant into waters of this Commonwealth designated to be protected for aquatic life in § 93.9(b) of this title (relating to designated water uses and water quality criteria) is proposed, a specific water quality criterion for such pollutant may be determined by the Department through establishment of a safe concentration value.

(b) Establishment of a safe concentration value shall be based upon data obtained from standard continuous flow bioassay tests which exist in substantial available literature or data obtained from specific tests utilizing representative important species of aquatic life designated by the Department and conducted in a water environment which is equal to or closely approximates that of the natural quality of the receiving waters.

(c) Safe concentration values of pollutants shall be determined by applying an application factor to the 96-hour LC50 value. Except where the Department determines, based upon substantial available data, that an alternate application factor exists for a pollutant, the following application factors shall be used in the determination of safe concentration values:

(1) Concentrations of pollutants that are nonpersistent or noncumulative shall not exceed 0.05 (1/20) of the 96-hour LC50.

(2) Concentrations of pollutants that are persistent or cumulative shall not exceed 0.01 (1/100) of the 96-hour LC50.

(d) Persons seeking issuance of a permit pursuant to the Clean Streams Law or an NPDES certification pursuant to Section 401 of the Federal Water Pollution Control Act — 33 U.S.C. § 1341 authorizing the discharge of a pollutant for which a safe concentration value is to be established using specific bioassay tests pursuant to subsection (c) of this section shall perform such testing under the direction of the Department and shall submit all of the following in writing to the Department:

(1) A plan proposing the bioassay testing to be performed,

(2) Such periodic progress reports of the testing as may be required by the Department,

(3) A report of the completed results of such testing including, but not limited to;

(i) all data obtained during the course of testing; and

(ii) all calculations made in the recording, collection, interpretation, and evaluation of such data.

(e) Bioassay testing shall be conducted in accordance with the methodologies outlined in EPA Ecological Research Series Publication, EPA-660/3/75-009, Methods of Acute Toxicity Tests with Fish, Macroinvertebrates, and Amphibians (April, 1975); Standard Methods for the Examination of Water and Wastewater (14th Edition); or Standard Method of Test for ASTM D1345-59 (Reapproved 1970) and published in the 1975 Annual Book of ASTM Standards — Part 31 — Water. Use of any other methodologies shall be subject to prior written approval by the Department. Test waters shall be reconstituted according to recommendations and methodologies specified in the previously cited reference or methodologies approved in writing by the Department.

TABLE 2.1.6.-10

PROPOSED WATER QUALITY STANDARDS AS OF MARCH 1978: SPECIFIC WATER QUALITY CRITERIA

Source (11)

Parameter	*Symbol*	*Criteria*
Aluminum	Al	Not to exceed 0.1 of the 96-hour LC50 for representative important species.
Alkalinity	Alk$_1$	Equal to or greater than 20 mg/l as $CaCo_3$ for fresh water aquatic life, except where natural conditions are less. Where discharges are to waters with 20 mg/l or less alkalinity, the discharge should not further reduce the alkalinity of the receiving waters.
	Alk$_2$	Not less than 20 mg/l.
	Alk$_3$	Between 20 and 100 mg/l.
	Alk$_4$	Between 20 and 120 mg/l.
Ammonia Nitrogen	Am$_1$	Not more than 0.5 mg/l.
	Am$_2$	Not more than 1.5 mg/l.
Arsenic	As	Not to exceed 0.05 mg/l total arsenic.
Bacteria	Bac$_1$	During the swimming season (May 1 through September 30), the fecal coliform level shall not exceed a geometric mean of 200 per 100 milliliters (ml) based on five consecutive samples each sample collected on different days; for the remainder of the year, the fecal coliform level shall not exceed a geometric mean of 2000 per 100 milliliters (ml) based on five consecutive samples collected on different days.
	Bac$_2$	(Coliforms/100 ml) — Not more than 5,000/100 ml as a monthly average value, nor more than this number in more than 20% of the samples collected during any month, nor more than 20,000/100 ml in more than 5% of the samples.
	Bac$_3$	(Coliforms/100 ml) — Not more than 5,000/100 ml as a monthly geometric mean.
	Bac$_4$	(Fecal Coliforms/100 ml) — Maximum geometric mean of 770/100 ml; samples shall be taken at a frequency and location to permit valid interpretation.
Chloride	Ch$_1$	Not more than 150 mg/l.
	Ch$_2$	Not more than 250 mg/l.
	Ch$_3$	Not more than 200 mg/l.
	Ch$_4$	Maximum 15-day mean 50 mg/l.
Chromium	Cr	Not to exceed 0.05 mg/l as hexavalent chromium.
Color	Col	Not more than 75 units on the platinum-cobalt scale; no other colors perceptible to the human eye.
Copper	Cu	Not to exceed 0.1 of the 96-hour LC50 for representative important species.
Cyanide	CN	Not to exceed 0.005 mg/l as free cyanide.
Dissolved Oxygen	DO$_1$	Minimum daily average 6.0 mg/l; no value less than 5.0 mg/l. For lakes, ponds and impoundments only, no value less than 5.0 mg/l at any point.
	DO$_2$	Minimum daily average 5.0 mg/l; no value less than 4.0 mg/l. For the epilimnion of lakes, ponds and impoundments, minimum daily average of 5.0 mg/l, no value less than 4.0 mg/l.
	DO$_3$	Minimum daily average not less than 5.0 mg/l; during periods 4/1-6/15 and 9/16-12/31 not less than 6.5 mg/l as a seasonal average.
	DO$_4$	Minimum daily average not less than 3.5 mg/l; during periods 4/1-6/15 and 9/16-12/31, not less than 6.5 mg/l as a seasonal average.
	DO$_5$	For the period 2/15 to 7/31 of any year, minimum daily average of 6.0 mg/l, no value less 5.0 mg/l. For the remainder of the year, minimum daily average of 5.0 mg/l, no value less than 4.0 mg/l.
	DO$_6$	No value less than 7.0 mg/l.
Fluoride	F	Not to exceed 2.0 mg/l.
Hardness	Hd$_1$	Maximum monthly mean 150 mg/l.
	Hd$_2$	Maximum monthly mean 95 mg/l.
Iron	Fe	Not to exceed 1.5 mg/l as a total iron; not to exceed 0.3 mg/l as dissolved iron.
Lead	Pb	Not to exceed 0.05 mg/l.
Manganese	Mn	Not to exceed 1.0 mg/l as total manganese.
Methylene	MBAS$_1$	Not more than 0.5 mg/l.

TABLE 2.1.6.-10 (Continued)

Parameter	*Symbol*	*Criteria*
Blue Active Substance	$MBAS_2$	Not more than 1.0 mg/l.
Nickel	Ni	Not to exceed 0.01 of the 96-hour LC50 for representative important species.
Nitrite plus Nitrate	N	Not to exceed 10 mg/l as nitrate nitrogen.
pH	pH_1	Not less than 6.0 and not more than 9.0.
	pH_2	Not less than 6.5 and not more than 8.5.
	pH_3	Not less than 7.0 and not more than 9.0.
Phenol	$Phen_1$	Not to exceed 0.005 mg/l.
	$Phen_2$	Maximum 0.02 mg/l.
Phosphorus (Total Soluble as PO_4)	P_1	Not more than 0.10 mg/l.
	P_2	Not more than 0.30 mg/l.
	P_3	Not more than 0.40 mg/l.
Radioactivity	Rad	Alpha emitters, maximum 3 pc/1; beta emitters, maximum 1,000 pc/1.
Sulfate	S	Not to exceed 250 mg/l.
Temperature	$Temp_1$	No measurable rise when ambient temperature is 58°F. or above; not more than 5°F. rise above ambient temperature until stream temperature reaches 58°F.; not to be changed by more than 2°F. during any one-hour period.
	$Temp_2$	No measurable rise when ambient temperature is 87°F. or above; not more than 5°F. rise above ambient temperature until stream temperature reaches 87°F.; not to be changed by more than 2°F. during any one-hour period.
	$Temp_3$	For the period 2/15 to 7/31, no measurable rise when ambient temperature is 74°F. or above; not more than 5°F. rise above ambient temperature until stream temperature reaches 74°F., not to be changed by more than 2°F. during any one-hour period; for the remainder of the year, no measurable rise when ambient temperature is 87°F. or above; not more than 5°F. rise above ambient temperature until stream temperature reaches 87°F., not to be changed by more than 2°F. during any one-hour period.
	$Temp_4$	Not to exceed the following temperatures in the month indicated:

Month	*Temperature, °F.*
January	56
February	56
March	62
April	71
May	80
June	90
July	90
August	90
September	90
October	78
November	69
December	58

	$Temp_5$	Not more than 5°F. above the average daily temperature during the 1961-66 period, which is shown below, or a maximum of 86°F., whichever is less.

Average Daily Temperature
1961-1966
(Temperatures May Be Interpolated)

Date	*Delaware Estuary, Head of Tide to River Mile 108.4 (about 1 mile below Pennypack Creek)* °F	*Delaware Estuary, River Mile 108.4 (about 1 mile below Pennypack Creek) to Big Timber Creek* °F	*Delaware Estuary, from Big Timber Creek to Pennsylvania-Delaware State Line* °F
January 1	37	41	42
February 1	35	35	36
March 1	38	38	40
April 1	46	46	47
May 1	58	58	58
June 1	71	71	72
July 1	79	79	80
August 1	81	81	81

TABLE 2.1.6.-10 (Continued)

Date	*Delaware Estuary, Head of Tide to River Mile 108.4 (about 1 mile below Pennypack Creek)*	*Delaware Estuary, River Mile 108.4 (about 1 mile below Pennypack Creek) to Big Timber Creek*	*Delaware Estuary, from Big Timber Creek to Pennsylvania-Delaware State Line*
September 1	78	79	78
September 15	76	77	76
October 1	70	70	70
November 1	59	61	60
December 1	46	50	50
December 15	40	45	45

	Temp$_6$	Not more than 5°F. rise above the ambient temperatures until stream temperatures reach 50°F., nor more than 2°F. rise above ambient temperature when temperatures are between 50°F. and 58°F., nor shall temperatures exceed 58°F., whichever is less, except in designated heat dissipation areas.
	Temp$_7$	As a guideline, the maximum length of heat dissipation areas shall not be longer than 3,500 feet measured from the point where the waste discharge enters the stream. The width of heat dissipation areas shall not exceed two-thirds the surface width measured from shore to shore at any stage of tide or the width encompassing one-fourth the cross-sectional area of the stream, whichever is less. Within any one heat dissipation area only one shore shall be used in determining the limits of the area. Where waste discharges are close to each other, additional limitations may be prescribed to protect stream uses. Controlling temperatures shall be measured outside the heat dissipation area. The rate of temperature change in the heat dissipation area shall not cause mortality of the fish.
	Temp$_8$	As a guideline, the maximum length of heat dissipation areas shall not be longer than 3,500 feet or 20 times the average stream width, whichever is less, measured from the point where the waste discharge enters the stream. Heat dissipation areas shall not exceed one-half the surface stream width or the width encompassing one-half of the entire cross sectional areas of the stream, whichever is less. Within any one heat dissipation area, only one shore shall be used in determining the limits of the area. Where waste discharges are close to each other, additional limitations may be prescribed to protect water uses. Controlling temperatures shall be measured outside the heat dissipation zone. The rate of temperature change in designated heat dissipation areas shall not cause mortality of the fish.
	Temp$_9$	As a guideline, the maximum length of heat dissipation areas shall not be longer than 1,000 feet or 20 times the average width of the stream, whichever is less, measured from the points where the waste discharge enters the stream. Heat dissipation areas shall not exceed one-half the surface stream width or the width encompassing one-half of the entire cross sectional area of the stream, whichever is less. Within any one heat dissipation area, only one shore shall be used in determining the limits of the area. Where waste discharges are close to each other, additional limitations may be prescribed to protect water uses. Controlling temperatures shall be measured outside the heat dissipation zone. The rate of temperature change in designated heat dissipation areas shall not cause mortality of the fish.
Threshold Odor Number	TON	Not more than 24 at 60°C.
Total Dissolved Solids	TDS$_1$	Not more than 500 mg/l as a monthly average value; not more than 750 mg/l at any time.
	TDS$_2$	Not more than 1,500 mg/l at any time.
	TDS$_3$	Not to exceed 133% of ambient stream concentrations or 500 mg/l, whichever is less.
	TDS$_4$	Not to exceed 133% of ambient stream concentration.
Turbidity	Tur$_1$	Not more than 30 NTU during the period 5/30-9/15, nor more than a monthly mean of 40 NTU or a maximum of 150 NTU during the remainder of the year.
	Tur$_2$	Maximum monthly mean 40 NTU, maximum value not more than 150 NTU.
	Tur$_3$	Not more than 100 NTU.
	Tur$_4$	For the period 5/15-9/15 of any year, not more than 40 NTU; for the period 9/16-5/14 of any year, not more than 100 NTU.
	Tur$_5$	Maximum monthly mean of 10 NTU; maximum of 150 NTU.
	Tur$_6$	Maximum monthly mean of 20 NTU, maximum of 150 NTU.
	Tur$_7$	Maximum monthly mean of 30 NTU, maximum of 150 NTU.
Sulfate	Sul	Not to exceed 250 mg/l.
Zinc	Zn	Not to exceed 0.01 of the 96-hour LC50 for representative important species.

TABLE 2.1.6. - 11
PROPOSED WATER QUALITY STANDARDS (AS OF MARCH 1978) FOR MAJOR STREAMS IN THE PA ORBES REGION
SOURCE (11)

Drainage List (See Fig. 2.1.6.-9)	Stream	Zone	County	Water Uses Protected	Exceptions to Specific Criteria
Q	Allegheny River	Main Stem	Clarion	WWF	Add Ch_1 $MBAS_1$ and TON
	Tionesta Creek	Main Stem From Farnsworth Branch to Allegheny River	Forest	CWF	None
	Oil Creek	Main Stem	Venango	CWF	Add TON
	French Creek	Main Stem	Venango	WWF	Add $MBAS_1$ TON and Am_2
	Sugar Creek	Basin	Venango	CWF	Add Am_1
	Sandy Creek	Main Stem	Venango	WWF	Add Am_2
R	Clarion River	Main Stem	Clarion	CWF	Add TON
	Clarion River (East Branch)	Basin	Elk	HQ-CWF	Add TON
	West Branch Clarion River	Main Stem	Elk	CWF	Add TON
	Spring Creek	Basin	Elk	HQ-CWF	Add TON
	Toby Creek	Basin	Clarion	CWF	Add TON
S	Allegheny River	Main Stem	Armstrong	WWF; Add N	None
	Bear Creek	Main Stem	Armstrong	CWF	Add Am_1
	Redbank Creek	Main Stem	Armstrong	TSF	Add Am_1
	Sandy Lick Creek	Main Stem	Jefferson	TSF	Add Am_1
	Mahoning Creek	Main Stem	Armstrong	WWF	Add Am_2
	Little Mahoning Creek	Basin	Indiana	HQ-CWF	Add Am_1
	Cowanshannock Creek	Basin	Armstrong	WWF	Add Am_2
	Crooked Creek	Main Stem	Armstrong	WWF	Add Am_2
T	Kiskiminetas River	Main Stem	Armstrong	WWF	Add Am_2
	Conemaugh River	Main Stem	Westmoreland	WWF	Add Am_2
	Stony Creek	Main Stem from Source to Beaverdam Creek	Somerset	CWF	Add Am_1
		Main Stem from Beaverdam Creek to Quemahoning Creek	Somerset	TSF	Add Am_1

TABLE 2.1.6. - 11 (continued)

Drainage List (See Fig. 2.1.6.-9)	Stream	Zone	County	Water Uses Protected	Exceptions to Specific Criteria
T(Continued)	Stony Creek (Cont.)	Main Stem from Quemahoning Creek to Conemaugh River	Cambria	WWF	Add Am_2
	Two Lick Creek	Main Stem	Indiana	TSF	Add Am_1
	Loyalhanna Creek	Basin from Source to Laughlintown Run	Westmoreland	HQ-CWF	Add Am_1
		Main Stem from Laughlintown Run to Miller Run	Westmoreland	TSF	Add Am_1
		Main Stem from Miller Run to Kisiminetas River	Westmoreland	WWF	Add Am_2
U	Allegheny River	Main Stem from Redbank Creek to Kiskiminetas River	Armstrong	WWF; Add N	None
		Main Stem from Kiskiminetas River to Ohio River	Allegheny	WWF; Add N	Add TON
	Buffalo Creek	Basin From Source to Little Buffalo Creek	Butler	HQ-CWF	None
		Basin From Little Buffalo Creek to Allegheny River	Butler	TSF	None
	Deer Creek	Basin From Source to Little Deer Creek	Allegheny	CWF	None
		Basin from Little Deer Creek to Allegheny River	Allegheny	WWF	None
	Plum Creek	Basin	Allegheny	TSF	None
	Pine Creek	Basin from Source to North Park Lake Dam	Allegheny	CWF	Add P_1
		Basin from North Park Lake Dam to Allegheny River	Allegheny	TSF	Delete TDS_1 Add TDS_2
V	Monongahlela River	Main Stem	Allegheny	WWF; Add N	Add TON
	Cheat River	Main Stem	Fayette	WWF	None

TABLE 2.1.6.-11 (continued)

Drainage List (See Fig. 2.1.6.-9)	Stream	Zone	County	Water Uses Protected	Exceptions to Specific Criteria
V (Continued)	Dunkard Creek	Main Stem	Greene	WWF	None
	Georges Creek	Main Stem	Fayette	WWF	Add Am_2
	Whiteley Creek	Basin	Green	WWF	Add Am_2
	Tenmile Creek	Basin from Source to South Fork Tenmile Creek	Greene	TSF	Add Am_2
		Basin From South Fork Tenmile Creek to Monongahela River	Greene	WWF	Add Am_2
	South Fork Tenmile Creek	Basin from Source to Browns Creek	Greene	HQ-WWF	Add Am_2
		Basin from Browns Creek to Tenmile Creek	Greene	WWF	Add Am_2
	Dunlap Creek	Basin	Fayette	WWF	Add Am_2
	Redstone Creek	Basin	Fayette	WWF	Add Am_2
	Peters Creek	Basin	Allegheny	TSF	None
	Youghiogheny River	Main Stem From Maryland-Pennsylvania State Line to Youghiogheny River Dam	Fayette	WWF	Delete $Temp_2$ Add $Temp_1$
		Main Stem From Youghiogheny River Dam to Connell Run	Fayette	HQ-CWF	None
		Main Stem From Connell Run to Monongahela River	Allegheny	WWF	None
	Casselman River	Main Stem	Somerset	WWF	None
	Laurel Hill Creek	Basin	Somerset	HQ-CWF	Add Am_1
	Indian Creek	Basin from Source to Champion Creek	Fayette	HQ-CWF	Add Am_1
	Jacobs Creek	Basin from Source to Bridgeport Reservoir Dam	Fayette	CWF	Add Am_1

TABLE 2.1.6.-11 (Continued)

Drainage List (See Fig. 2.1.6.-9)	Stream	Zone	County	Water Uses Protected	Exceptions to Specific Criteria
V(Continued)	Jacobs Creek (Continued)	Basin from Bridgeport Reservoir Dam to Youhiogheny River	Fayette	TSF	Add Am$_2$.
	Sewickley Creek	Basin From Source to Brinkers Run	Westmoreland	HQ-CWF	None
		Main Stem from Brinkers Run to Youghiogheny River	Westmoreland	WWF	None
	Turtle Creek	Main Stem from Source to Brush Creek	Allegheny	TSF;Delete PWS	Delete TDS$_1$ Mn and Si Add TDS$_2$
		Main Stem from Brush Creek to the Monongahela River	Allegheny	WWF; Delete PWS	Delete TDS$_1$ Mn and Si Add TDS$_2$
	Abers Creek	Basin	Allegheyn	TSF;Delete PWS	Delete TDS$_1$ Mn and Si Add TDS$_2$
W	Ohio River	Main Stem	Beaver	WWF; Add N	Shown Below

Exceptions to Specific Criteria for Ohio River Main Stem:

Delete: CN and F;

Add:

Ammonia - The concentration of un-ionized ammonia (NH_3) shall not exceed 0.05 mg/l as N.

Barium - Total barium shall not exceed 1.0 mg/l.

Cadmium - Total cadmium shall not exceed 0.01 mg/l.

Chloride - Chloride shall not exceed 250 mg/l.

Cyanide - Total cyanide shall not exceed 0.025 mg/l; free cyanide shall not exceed 0.005 mg/l.

Fluroide - Total fluoride shall not exceed 1.0 mg/l.

Nitrite - Nitrite shall not exceed 1.0 mg/l as N.

Selenium - Total selenium shall not exceed 0.01 mg/l.

Silver - Total silver shall not exceed 0.05 mg/l.

Radionuclides - Gross total alpha activity (including radium-226 but excluding radon and uranium) shall not exceed 15 picocurie per litre (pCi/l) and combined radium-226 and radium 228 shall not exceed 5 pCi/l; provided that specific determinations of radium-226 and radium-228 are not required if gross particle activity does not exceed 5 pCi/l. Concentration of total gross beta particle activity shall not exceed 50 pCi/l; the concentration of tritium shall not exceed 20,000 pCi/l; the concentration of total strontium-90 shall not exceed 8 pCi/l.

Mercury - Total organism body burden of any aquatic species shall not exceed 0.5 micrograms/gram as total mercury. Total mercury concentration (unfiltered) in any water sample shall not exceed 0.2 micrograms/liter.

TABLE 2.1.6.-11 (Continued)

Drainage List (See Fig. 2.1.6.-9	Stream	Zone	County	Water Uses Protected	Exceptions to Specific Criteria
W (Continued)	Ohio River (Continued)				PCB - Total PCB shall not exceed 1 nanograms per liter; however, when the level in water is less than the practical laboratory quantification level, a fish flesh body burden level in excess of 2 ppm shall be cause for concern and further investigation.
	Chartiers Creek	Main Stem	Allegheny	TSF	None
	Beaver River	Main Stem	Beaver	WWF; Add N	Add TON
	Mahoning River	Main Stem	Lawrence	WWF	Shown Below
					Exceptions to Specific Criteria for Mahoning River Main Stem: Delete: the entire list. Add: As, Ch_2, Cr, DO_2, F, Pb, Mn, N, S, $Temp_4$, TDS_1 pH - Not less than 6.0 and not more than 8.5. Total Iron - Not more than 1.0 mg/l. Threshold Odor Number - Not to exceed 24 at 60°C as a daily average. Total Cyanide - Not to exceed 0.025 mg/l. Free Cyanide - Not to exceed 0.005 mg/l. Phenolics - Not to exceed 0.010 mg/l. Ammonia - Un-ionized ammonia not to exceed 0.02 mg/l. Cadmium - Not to exceed 0.01 mg/l (total). Total Chromium - Not to exceed 0.1 mg/l. PCB - Not to exceed 1 nanogram per liter. Copper - Not to exceed 0.02 mg/l (total). Nickle - Not to exceed 0.1 mg/l (total). Zinc - Not to exceed 0.2 mg/l (total)
	Shenango River	Main Stem from Pymatuning Dam to Beaver River	Lawrence	WWF	Add TON
		Main Stem from Source to Pymatuning Reservoir Dam	Crawford	WWF	Add Am_2
	Connoquenessing Creek	Basin from Source to Oneida Dam	Butler	HQ-WWF	None
		Main Stem from Lake Oneida Dam to Beaver River	Lawrence	WWF	None

TABLE 2.1.6.-11 (Continued)

Drainage List (See Fig. 2.1.6.-9)	Stream	Zone	County	Water Uses Protected	Exceptions to Specific Criteria
W(continued)	Slippery Rock Creek	Basin From Source to Muddy Creek	Lawrence	CWF	None
		Basin From Muddy Creek to Connoquenessing Creek	Lawrence	CWF	None
	Raccoon Creek	Main Stem	Beaver	WWF	None
L*	West Branch Susquehanna River	Main Stem		WWF	Add Am_2
	Chest Creek	Basin, Source to Patton Water Supply	Clearfield	HQ-CWF	Add Am_1
		Basin, Patton Water Supply to Mouth	Clearfield	CWF	Add Am_1
	Anderson Creek	Basin	Clearfield	HQ-CWF	Add Am_1
		Dubois Dam to Mouth	Clearfield	CWF	Add Am_1
	Clearfield Creek	Main Stem	Clearfield	WWF	Add Am_2
	Moshannon Creek	Main Stem	Clearfield-Centre	TSF	Add Am_1
	Bennett Branch Sinnemahoning Creek	Main Stem	Cameron	WWF	Add Am_2
N*	Raystown Branch Juniata River	Basin, Source to Somerset-Bradford County Line	Bedford-Somerset	CWF	None
Z*	Wills Creek	Main Stem, Source to PA MD Border	Bedford Somerset	CWF	Add Am_1

*Not in the Ohio River Basin

2.1.6.4 SURFACE WATER QUALITY

Natural variations in the quality of the surface waters of the ORBES Region in western Pennsylvania, caused by areal differences in geology and topography were further enhanced by concentration of population and industrial development during the last 150 years. Many of the streams have become severely polluted by sewage, industrial waste, and acid mine drainage while others were only mildly affected and a few escaped degradation.

Following the requirements of the 1972 Federal Water Pollution Control Act Amendments and the guidelines for waste effluent characteristics established by the U.S.E.P.A., the PA Department of Environemtnal Resources assessed the streams in Pennsylvania as to the limitations needed to meet water quality criteria and also assigned a priority value to each stream for abatement program purposes. This resulted in a classification system of streams consisting of three classes and three categories. Class is related to the type of problem in the stream or stream segment, category refers to the priority for abatement as defined below (2).

> Class I designates "effluent limited" streams---those streams which can meet 1983 water quality criteria if minimum effluent treatment requirements are satisfied. (Designated by "EL" in subsequent Tables).
>
> Class II - designates "water quality limited" streams---those in which the 1983 criteria will not be met unless effluent treatment or control beyond the minimum requirement is provided. ("WQL" in the Tables.)
>
> Class III - designates "acid mine drainage affected" streams---those streams in which acid mine drainage prevents meeting the 1983 water quality criteria regardless of the treatment level of other effluents. (Designated by "AMD" in subsequent Tables).
>
> In Category I, a significant portion of the segment has: (1) existing or potential point sources of pollution that would violate water quality standards with "best practicable treatment" in use, (2) relatively large population and industrial concentrations in relation to stream flows, (3) been identified as an area with very high growth and development potential, (4) high quality waters which need special protection, or (5) a combination of the above. Most Category I segments are water quality limited segments.

Category II segments have: (1) existing or point sources of pollution which will meet water quality standards with best practicable treatment, (2) been identified as areas with moderate or low growth and development potential, (3) have limited non-point source pollution from abandoned coal mine drainage, or (4) a combination of the above. Most Category II segments are effluent limited segments.

Category III segments have water quality problems caused by drainage from abandoned mines which will prevent attaining water quality standards even with "perfect" point source controls.

Due to accelerated protective measures, such as wastewater treatment and the control of acid mine drainage, several of the streams have shown considerable water quality improvement in recent years. There are programs underway or planned to correct pollution problems on many more streams and the stream miles meeting water quality criteria continue a positive trend. The 1978 Pennsylvania Water Quality Inventory Report (25) indicates that approximately 80 percent of the state's streams were meeting in 1977 the "fishable-swimmable" standards as established under the Federal Water Pollution Control Act, as amended. It was estimated that approximately 85 percent of the state's waters will meet the water quality standards by 1983, bacterial criteria not included.

Surface water quality problems associated with municipal waste, industrial waste, and acid mine drainage are discussed in more detail in Sections 2.1.6.5 and 2.1.6.6. In this section the general quality of the surface waters is described separately for the Monongahela, Allegheny, and Ohio River Mainstem Basins.

A. Monongahela River Basin

1. General

The surface waters of the Monongahela River Basin consist primarily of calcium sulfate waters whose chemical quality is influenced by pollution from acid mine drainage. The acid mine drainage from the bituminous coal fields underlying the area lowers the pH and causes high concentrations of free sulfuric acid, sulfate, and trace metals especially iron, aluminum, and manganese (14). The acid load carried into the Monongahela by its tributaries exceeds its neutralizing capacity. The bulk of the residual mineral acidity comes from the small streams tributary to the main stem, the principal tributaries contribute only 30% of the mineral acidity to the main stem (15). A study in 1963 found the Monongahela to be acid at all points examined with pH values less than 5.0. Most interstate tributaries were found acid also: the Cheat River and Dunkard Creek had pH values less than 5.0. Laurel Run in the headwaters of the Youghiogheny had an average pH value of 3.5. The Youghiogheny was alkaline at the state line but became acid downstream (16).

The acid conditions of the streams mask the effects of organic and bacterial pollution originating from municipal and industrial discharges. Coliform and fecal streptococci concentrations in the Monongahela were generally low and dissolved oxygen concentrations generally high in the 1963 study reflecting the inhibiting action of the acid conditions in the stream on micro-organisms. However, calculations indicated that under non-acid conditions and 1963 bacterial loads nowhere would the coliform densities drop to near the 1,000 per 100 ml level (16).

A 1964/65 study found significant increases in the lower reach of the Monongahela River in the following components: BOD, hardness, calcium, magnesium, sulfate, chloride, phenolics, total organic carbon, sodium, potassium, organic nitrogen and total solids. The increase in these components was attributed to municipal and industrial sources. The mean concentration of phenol was always higher than the recommended limit for drinking water (1 ppb) (17).

A 1971 evaluation found the quality of the Monongahela River improving due to better waste treatment at mines, industries, and communities. The pH and alkalinity have improved significantly at Charleroi and Braddock on the Monongahela

River and at Sutersville and Connellsville on the Youghiogheny River. Mine drainage from abandoned coal mines was the major source of water pollution in the Basin, discouraging pollution abatement. No significant improvement was found in the phenol problem (18). The Environmental Protection Agency estimated that approximately 2550 pounds per day of phenol was discharged to the Monongahela River in 1971 by industries located on its main stem. Significant amounts of BOD, oil, heat, suspended solids and cyanide discharged into the Monongahela River were found to contribute substantially to the water quality problems of the Ohio River. Use of the Monongahela for contact recreation in its headwaters near Pittsburgh has been limited by oil, scum, floating debris and dangerously high bacterial counts (19).

A 1973 water quality assessment indicated further improvement in the upper portions of the Monongahela River but less improvement in the lower portions (20). Nevertheless, data from 58 water quality monitoring stations in the Monongahela Basin during 1972-73 (21) indicated that state water quality criteria for pH, fecal coliform, and iron were often exceeded at several stations in the basin (22).

In the summer of 1975 the Corps of Engineers conducted two sampling surveys of the entire length of the Monongahela River: one at an extreme combination of low-flow conditions and high air temperatures and another at an intermediate flow. The results again demonstrated that pH related problems in the Monongahela River Basin have been considerably reduced in the previous few years by abatement of acid mine drainage. It was also found that most of the water quality problems on the Monongahela River mainstem are low-flow related and the navigation structures on the river have a noticable effect on several important water quality parameters. Consequently, low-flow augmentation from impoundments is an important factor along the entire length of the river (23).

There are four major reservoirs currently in operation in the Monongahela

River Basin (see Table 2.1.5.-8). Two of these, Deep Creek Lake on Deep Creek (tributary to the Youghiogheny River) in Maryland and Lake Lynn on the Cheat River in West Virginia, are owned by private power companies and are operated primarily to produce peak load power. The two other reservoirs, Tygart River Lake on the Tygart River in West Virginia and Youghiogheny River Lake on the Youghiogheny River at the Pennsylvania/Maryland border, are operated by the Corps of Engineers for flood control, recreation, and low-flow augmentation for water quality and navigation. Tygart River Lake is operated to provide a minimum flow of 340 cfs in the Upper Monongahela River and Youghiogheny River Lake provides a minimum flow of 200 cfs at Connellsville, Pennsylvania.

The influence on water quality of the power producing reservoirs is minor. Flow and temperature pulsations due to the releases from Deep Creek Reservoir can be noticed during low flows in the Youghiogheny River at Friendsville, Maryland (24) but these are absorbed by Youghiogheny River Lake. Youghiogheny River Lake is a relatively deep and cool impoundment exhibiting summer thermal stratification from which the outflow is cooler than the inflow in the spring and warmer than the inflow in the autumn. This alteration of the Youghiogheny River temperature is somewhat mitigated by the confluence of the warmer Casselman River only 1.2 miles downstream of the Dam, but so is the impact of the acid mine drainage polluted Casselman River. The low-flow augmentation provided by high quality water from Youghiogheny River Lake has a favorable impact not only on the temperature, pH, and acidity of the Youghiogheny River but it substantially mitigates the acid mine drainage, thermal pollution, and low dissolved oxygen concentrations in the lower Monongahela River and this mitigation is also significant to the water quality of the Upper Ohio River (24). The impact depends on the selective magnitudes of the release from Youghiogheny River Lake and the flows in Casselman, Cheat, Monongahela and Ohio Rivers.

The pH of the Monongahela River mainstem was judged good in 1975 even at low flow conditions (generally just slightly less than 7.0) except a 20 to 25 mile stretch immediately below the West Virginia border (23). The depression in pH in this reach is caused by the acid Cheat River and other acid discharges feeding into the Monongahela River. As a result, pH and acidity "are no longer crucial considerations in the water quality of the lower Monongahela River. However, high total dissolved solids (predominantly sulfates) remain a problem." (24)

Local water quality problems on smaller streams in the Monongahela River Basin will be pointed out in subsequent tables.

2. Surface Water Quality

The yearly averages and ranges of water temperature, conductivity, dissolved oxygen, and pH for the lower Monongahela River are shown in Figure 2.1.6.-10 as calculated from ORSANCO's Robot Monitor Computer Printouts (6). There is no definite trend in temperature, conductivity, and dissolved oxygen but the improvement in pH is conspicuous in the figure. Figure 2.1.6.-10A shows the seasonal variation of the average monthly values for the same four parameters.

Table 2.1.6.-12 gives twelve-year means of selectd parameters at the WQN Stations along the Monongahela and Youghiogheny Rivers as calculated by EPA's STORET System (1), (2). Mean, maximum and minimum values of 39 parameters for two successive three-year periods are given in Tables 2.1.6.-13 and 2.1.6.-13A.

Perhaps more informative are the results of a few recent studies by the Corps of Engineers and the PA-DER on the Monongahela River and some of its tributaries during critical summer conditions. Figures 2.1.6.-11 through 2.1.6.-19 show the profiles of surface water temperature, surface dissolved oxygen concentration, pH, conductivity, sulfates, nonfiltrable solids, transparency, $NO_2 + NO_3$, and

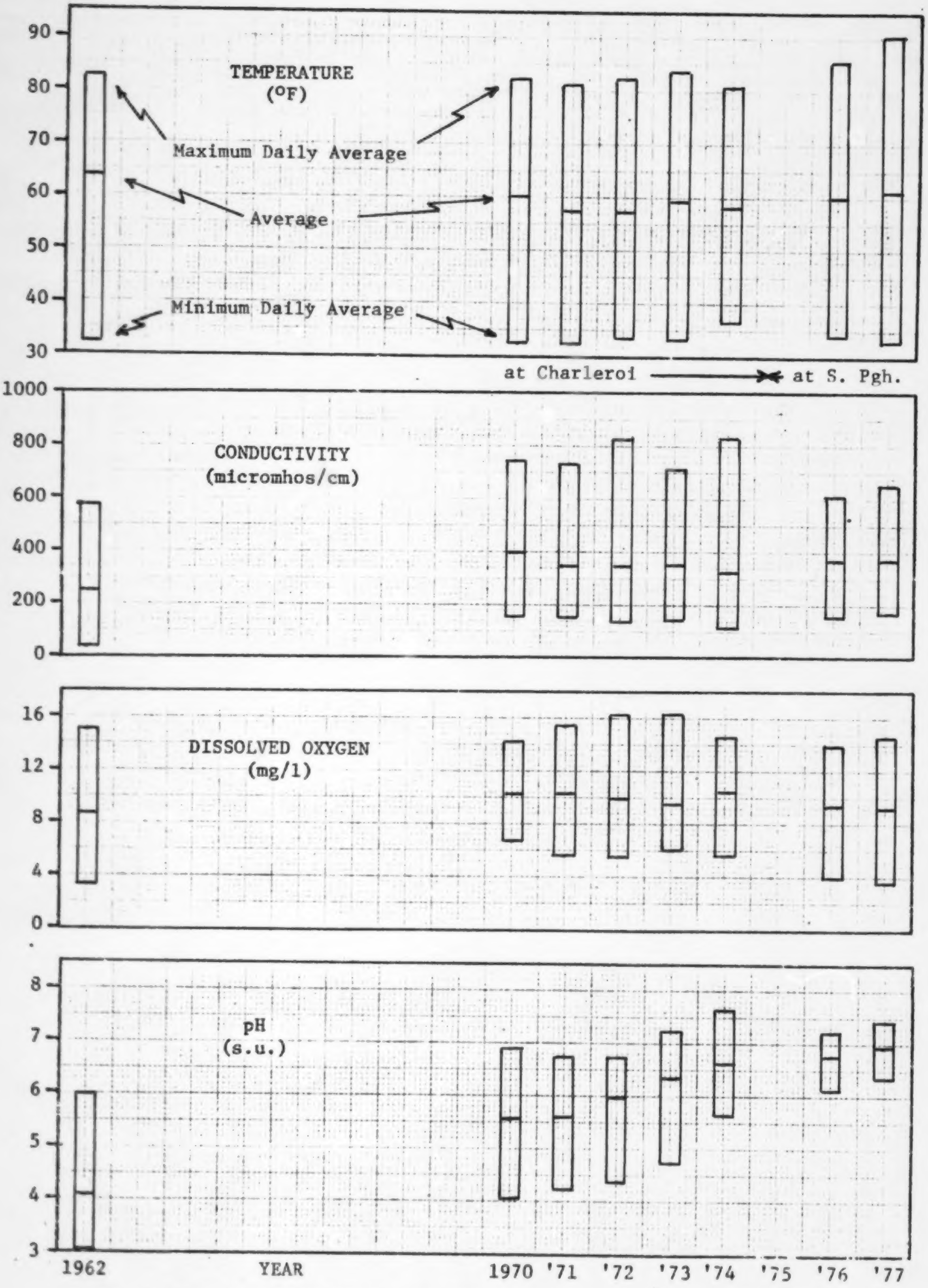


FIGURE 2.1.6.-10 ANNUAL WATER QUALITY -- MONONGAHELA RIVER Source (6)

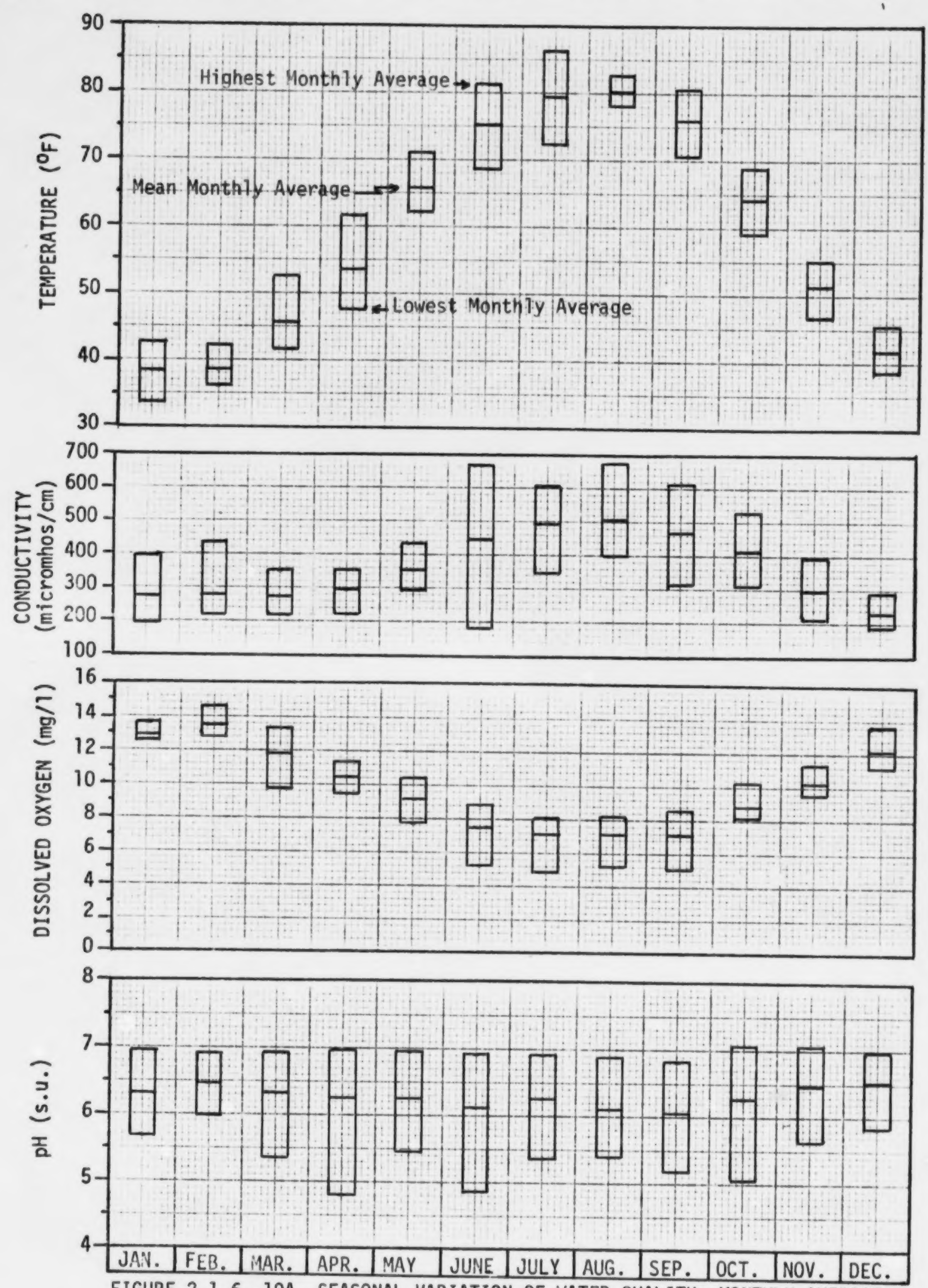


FIGURE 2.1.6.-10A SEASONAL VARIATION OF WATER QUALITY: MONTHLY AVERAGES — MONONGAHELA RIVER, 1970-1977 After Source (6)

TABLE 2.1.6.-12

MEAN VALUES OF SELECTED PARAMETERS AT SAMPLING STATIONS IN THE MONONGAHELA RIVER BASIN

(Data collected from June 1962 to December 1974)

Source (2)

Parameter	Stream					
	Monongahela River			Youghiogheny River		
	Sampling Station (PA-DER WQN No.)					
	701	702	703	706	707	708
pH (S.U.)	6.2	5.3	4.7	6.3	6.7	6.6
Dissolved Oxygen (mg/l)	8.5	8.6	9.0	9.2	10.4	10.3
Total Iron (ug/l)	2,825	1,925	2,847	2,943	399	751
Total Dissolved Solids (mg/l)	115	145	34	81	22	64
Temperature (°C)	12.6	12.3	12.9	11.7	10.1	12.4
Turbidity (JTU)	18.1	21.8	17.0	26.3	13.1	11.2
Ammonia (mg/l N)	0.27	0.23	0.36	0.13	0.08	0.09
Total Phosphorus (mg/l P)	0.18	0.09	0.08	0.09	0.21	0.19
Alaklinity (as $CaCO_3$) (mg/l)	20.0	12.6	3.5	13.8	12.0	14.8
Biochemical Oxygen Demand (mg/l)	2.3	1.4	1.2	1.9	1.3	1.6
Total Coliform (#/100 ml)	31,900	11,200	1,500	22,600	6,000	4,800

TABLE 2.1.6.-13

MONONGAHELA RIVER WATER QUALITY (from EPA STORET System)

Source (22)

	Lock & Dam 7 at Greensboro, Pennsylvania 1/4/72 to 4/18/73				Charleroi, Pennsylvania 1/3/72 to 9/12/74				Pittsburgh, Pennsylvania 1/24/72 to 10/17/73			
Parameter	Number of Samples	Mean Value	Maximum Value	Minimum Value	Number of Samples	Mean Value	Maximum Value	Minimum Value	Number of Samples	Mean Value	Maximum Value	Minimum Value
Water Temperature, °C	10	13.5	24.5	1	7	12.3	25	2	14	18.6	31	4
Flow, cfs	-	-	-	-	3	3,633	4,700	2,400	13	9,659	29,000	3,650
Turbidity, JTU	3	0.5	1	0.1	8	5.8	23	0.5	11	11.5	45	4
Threshold Odor Number	1	24 (at 60°C)	24	24	1	33.2 (at 60°C)*	33.2	33.2	3	0 (at 40°C)	0	0
Conductivity at 25°C, micromhos/cm	4	304	543	173	7	326	600	150	14	423	650	85
Dissolved Oxygen, mg/l	9	10.6	17.8	5.0	7	10.9	13	7	14	8.9	12.1	5.5
Biochemical Oxygen Demand, 5 day, mg/l	2	0.8	1.2	0.4	1	1.8	1.8	1.6	14	1.8	3.2	0.6
pH, units	8	5.1*	6.5	1.3*	7	6.2	6.9	5.3*	14	6.5	7	6.1
Total Alkalinity, mg/l as $CaCO_3$	4	1.3	3	0	9	15.8	27	2	11	18.4	38	7
Total Acidity, mg/l as $CaCO_3$	5	7.6	14	2	-	-	-	-	11	4.5	14	0
Total Residue, mg/l	-	-	-	-	2	416	512	320	11	235.9	343	186
Ammonia Nitrogen, mg/l	1	0.36	0.36	0.36	8	0.23	0.58	0.06	14	0.73	1.3	0.12
Nitrate Nitrogen, mg/l	2	0.43	0.5	0.36	8	0.77	1.14	0.4	11	0.69	0.86	0.46
Total Phosphorus, mg/l	1	0.08	0.08	0.08	8	0.09	0.2	0.04	11	0.06	0.09	0.03
Orthophosphate, mg/l	3	0.15	0.43	0.003	1	0.005	0.005	0.005	-	-	-	-
Oil and Grease, mg/l	-	-	-	-	-	-	-	-	5	20.9	35	1.2
Total Organic Carbon, mg/l	6	3.8	5.5	2.0	1	3.5	3.5	3.5	14	2.8	8	1.1
Total Hardness, mg/l as $CaCO_3$	3	99.7	130	84	9	130.6	228	57	11	130.4	170	92
Chloride, mg/l	3	4.7	6	3	9	8.1	16	4	11	12.1	17	6
Sulfate, mg/l	3	85.7	108	63	9	131.4	273	42	11	136.8	210	85
Dissolved Fluoride, mg/l	1	0.01	0.01	0.01	1	0.01	0.01	0.01	11	0.26	0.44	0.1
Cyanide, mg/l	-	-	-	-	-	-	-	-	14	0.025	0.07	0.01
#Arsenic, mg/l	1	0.01	0.01	0.01	-	-	-	-	6	0.0017	0.01	0
Barium, mg/l	-	-	-	-	-	-	-	-	2	0.039	0.078	0
#Cadmium, mg/l	1	0.004	0.004	0.004	2	0.005	0.005	0.005	5	0.0008	0.004	0
#Chromium, mg/l	1	0.001	0.001	0.001	2	0.005	0.01	0	5	0	0	0
#Copper, mg/l	1	0.013	0.013	0.013	2	0.055	0.1	0.01	6	0.003	0.018	0
Iron, mg/l	2	0.63	1	0.26	10	0.818	2.74*	0.02	9	1.16	2.3*	0.018
Manganese, mg/l	2	0.51	0.52	0.49	3	0.820	1.19	0.63	9	0.52	1	0.2
#Lead, mg/l	1	0.005	0.005	0.005	2	0.050	0.050	0.050	6	0.005	0.013	0
#Zinc, mg/l	1	0.15	0.15	0.15	2	0.120	0.200	0.040	3	0.05	0.06	0.04
Mercury, mg/l	1	0	0	0	2	0.0005	0.0005	0.0005	5	0.0004	0.0013	0
Total Coliforms, no./100 ml	6	263	480	4	-	-	-	-	11	7,236	27,000	700
Fecal Coliforms, no./100 ml	7	50.4	193	0	-	-	-	-	11	308*	950*	10
Phenols, mg/l	-	-	-	-	2	0.003	0.005	0.001	11	0.012*	0.038*	0.001

#Dissolved component only at Lock & Dam 7 at Greensboro, Pennsylvania.

*Exceeds Pennsylvania's specific water quality criteria.

Reproduced from best available copy.

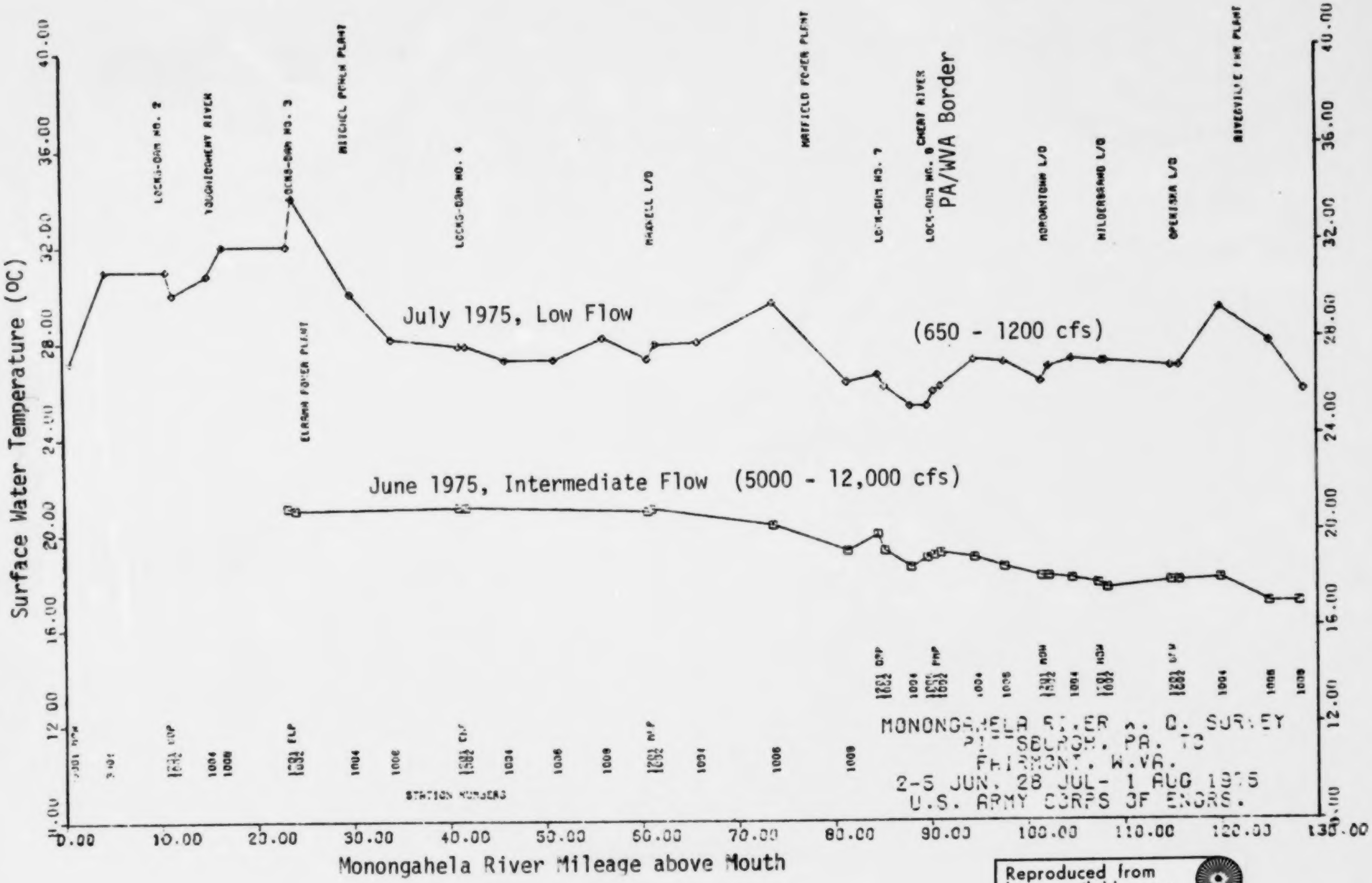
TABLE 2.1.6.-13A MONONGAHELA AND YOUGHIOGHENY RIVER WATER QUALITY, 1975-77

(From EPA's STORET System)

Parameter	WQN Station No. 701 Monongahela River at Braddock				WQN Station No. 703 Monongahela River Lock & Dam #7 at Greensburg				WQN Station No. 706 Youghiogheny River at Sutersville			
	No. of Samples	Mean Value	Maximum Value	Minimum Value	No. of Samples	Mean Value	Maximum Value	Minimum Value	No. of Samples	Mean Value	Maximum Value	Minimum Value
Water Temperature, °C	16	16.5	28.5	3.5	13	11.0	22.0	0	18	11.3	24.0	2.0
Flow, cfs	6	6,498	10,800	2,150	6	7,363	18,050	840	7	1,969	6,200	100
Turbidity, JTU	7	12.1	28.0	2.0	18	11.6	91.0	1.0	13	13.5	58.0	1.7
Conductivity at 25°C, micromhos/cm	16	411	600	200	20	290	500	161	23	259	450	130
Dissolved Oxygen, mg/l	16	9.2	12.3	6.9	5	10.8	12.2	8.7	5	10.3	13.0	8.8
pH, Standard Units	14	7.1	7.5	6.6	8	7.0	7.5	5.8	20	7.1	7.5	5.2
Total Alkalinity, mg/l as $CaCO_3$	16	29.9	54.0	15.0	22	14.3	30.0	2.0	24	18.5	40.0	7.0
Mineral Acidity, mg/l	15	0	0	0	14	0	0	0	24	0	0	0
Acidity from CO_2, mg/l	15	0	0	0	21	4.2	20.0	0	24	0	0	0
Total Residue, mg/l	--	--	--	--	--	--	--	--	--	--	--	--
Dissolved/105° Residue, mg/l	9	252	394	144	11	189	340	130	21	178	288	90
Total Nonfilterable Residue, mg/l	--	--	--	--	--	--	--	--	--	--	--	--
Settleable Residue, ml/l	--	--	--	--	--	--	--	--	--	--	--	--
Oil and Grease, mg/l	10	4.1	5.0	2.0	--	--	--	--	--	--	--	--
Total NH_3-N, mg/l	16	0.57	1.35	0.20	22	0.43	4.73	0.05	24	0.16	0.70	0.05
Total NO_2-N, mg/l	15	0.06	0.42	0.003	20	0.04	0.31	0.002	22	0.14	0.12	0.002
Total NO_3-N, mg/l	14	0.89	1.38	0.11	19	1.23	10.03	0.35	20	0.77	1.31	0.18
Total Phosphorus, mg/l P	16	0.83	9.59	0.02	22	0.19	1.31	0.02	24	0.13	0.78	0.02
Total Cyanide, mg/l	11	0.038	0.100	0.010	18	0.029	0.100	0.010	20	0.027	0.200	0.010
Total Hardness, mg/l as $CaCO_3$	15	127	170	74	22	105	195	40	24	85	129	30
Dissolved Calcium, mg/l	15	34.4	53.7	20.0	23	27.8	50.4	11.2	24	23.0	35.0	7.7
Dissolved Magnesium, mg/l	15	10.2	21.0	0	23	9.0	28.4	1.1	24	6.6	13.4	0.3
Chloride, mg/l	15	16.0	35.0	5.0	23	17.6	163	5.0	22	10.4	28.0	1.0
Total Sulfate, mg/l	16	123	220	40	23	107	235	42	23	70	145	20
Total Fluoride, mg/l	16	0.24	0.38	0.11	22	0.68	12.0	0.07	23	0.12	0.16	0.08
Total Arsenic, mg/l	--	--	--	--	--	--	--	--	--	--	--	--
Total Cadmium, mg/l	2	0.010	0.010	0.010	2	0.007	0.010	0.003	2	0.011	0.020	0.002
Total Chromium, mg/l	2	0.020	0.020	0.020	2	0.015	0.020	0.010	2	0.035	0.050	0.020
Total Copper, mg/l	2	0.015	0.020	0.010	2	0.010	0.015	0.005	2	0.030	0.050	0.010
Total Iron, mg/l	16	1.125	2.480	0.140	22	1.395	11.000	0.150	24	1.425	6.250	0.200
Total Lead, mg/l	2	0.050	0.050	0.050	2	0.038	0.050	0.025	2	0.125	0.200	0.050
Manganese, mg/l	15	0.267	0.380	0.100	2	0.365	0.500	0.230	24	0.203	0.400	0.040
Total Nickel, mg/l	2	0.050	0.050	0.050	2	0.038	0.050	0.025	2	0.038	0.050	0.025
Total Zinc, mg/l	2	0.120	0.200	0.040	2	0.260	0.495	0.025	2	0.030	0.030	0.030
Total Aluminum, mg/l	16	0.421	1.520	0.060	2	0.400	0.500	0.300	23	0.597	3.200	0
Total Coliforms, no./100 ml	--	--	--	--	1	80	80	80	--	--	--	--
Fecal Coliforms, no./100 ml	--	--	--	--	8	96	420	10	28	1,051	5,000	10
Total Phenols, mg/l	15	0.009	0.025	0.001	17	0.009	0.017	0.002	23	0.005	0.027	0.001
Total Mercury, mg/l	--	--	--	--	--	--	--	--	--	--	--	--

FIGURE 2.1.6.-11 MONONGAHELA RIVER SURFACE WATER TEMPERATURE

Source (23)



Reproduced from best available copy.

FIGURE 2.1.6.-12 MONONGAHELA RIVER SURFACE DISSOLVED OXYGEN CONCENTRATION

Source (23)

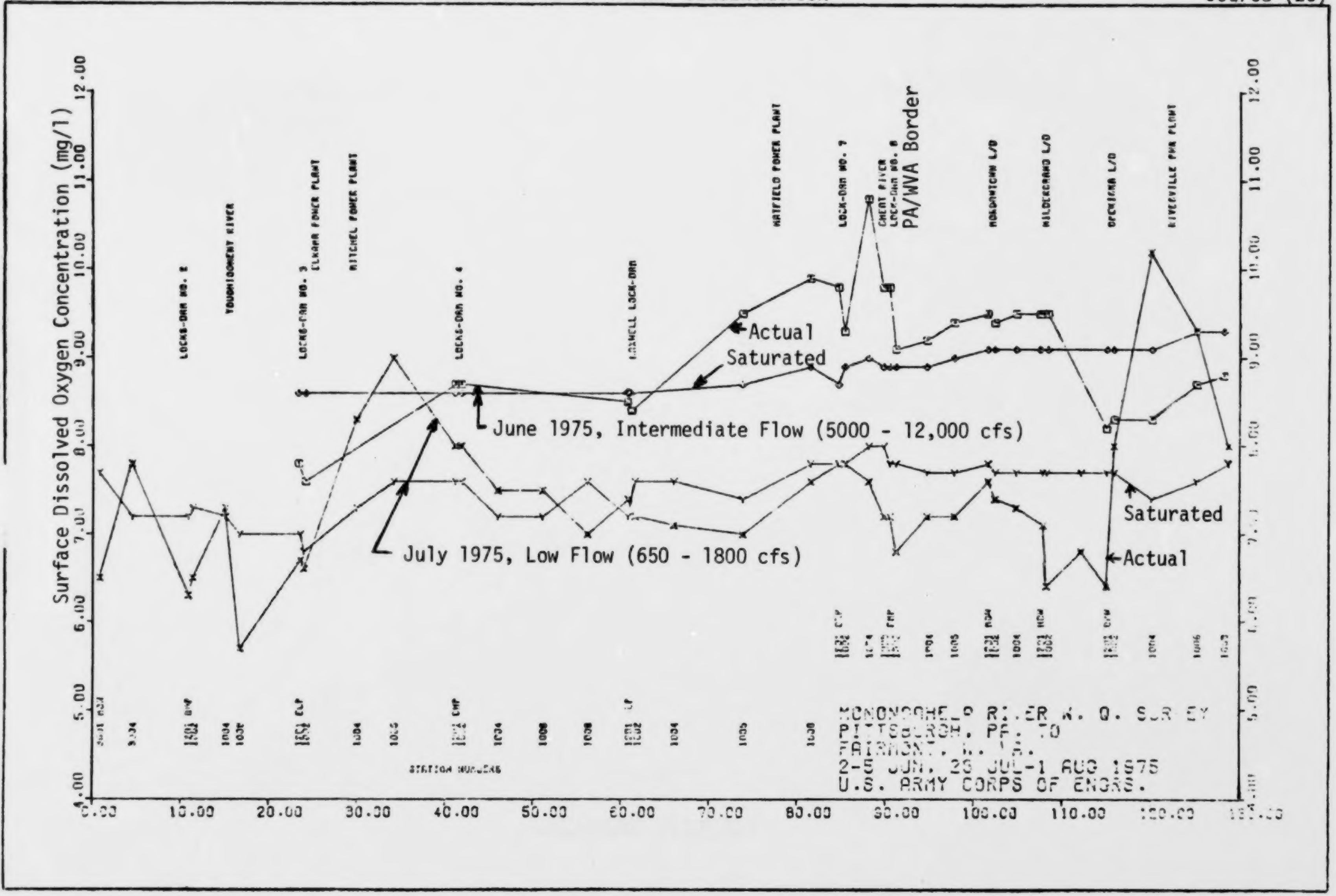
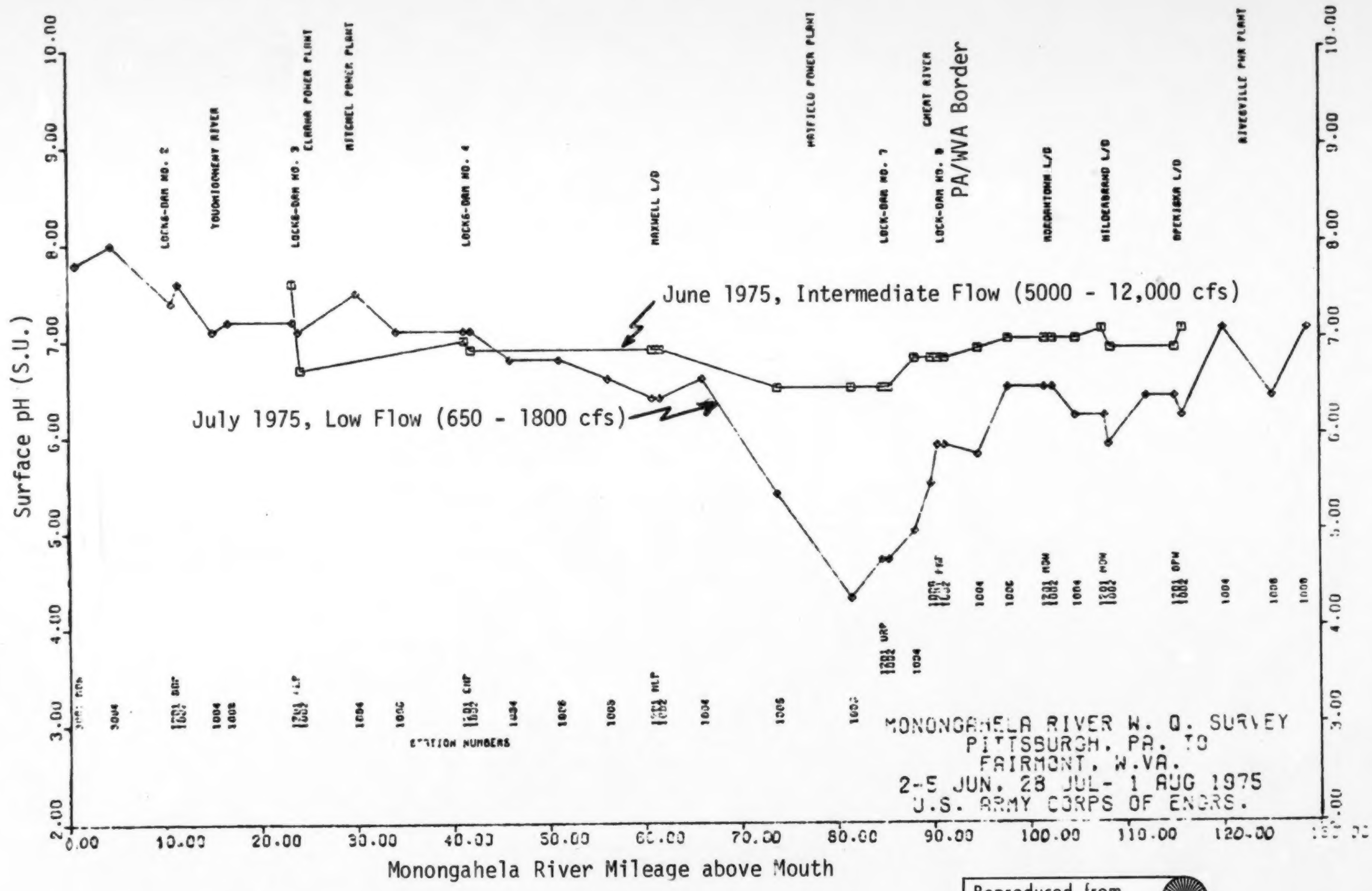


FIGURE 2.1.6.-13 MONONGAHELA RIVER SURFACE pH

Source (23)



Reproduced from best available copy.

FIGURE 2.1.6.-14 MONONGAHELA RIVER CONDUCTIVITY (Midstream at Surface)

Source (23)

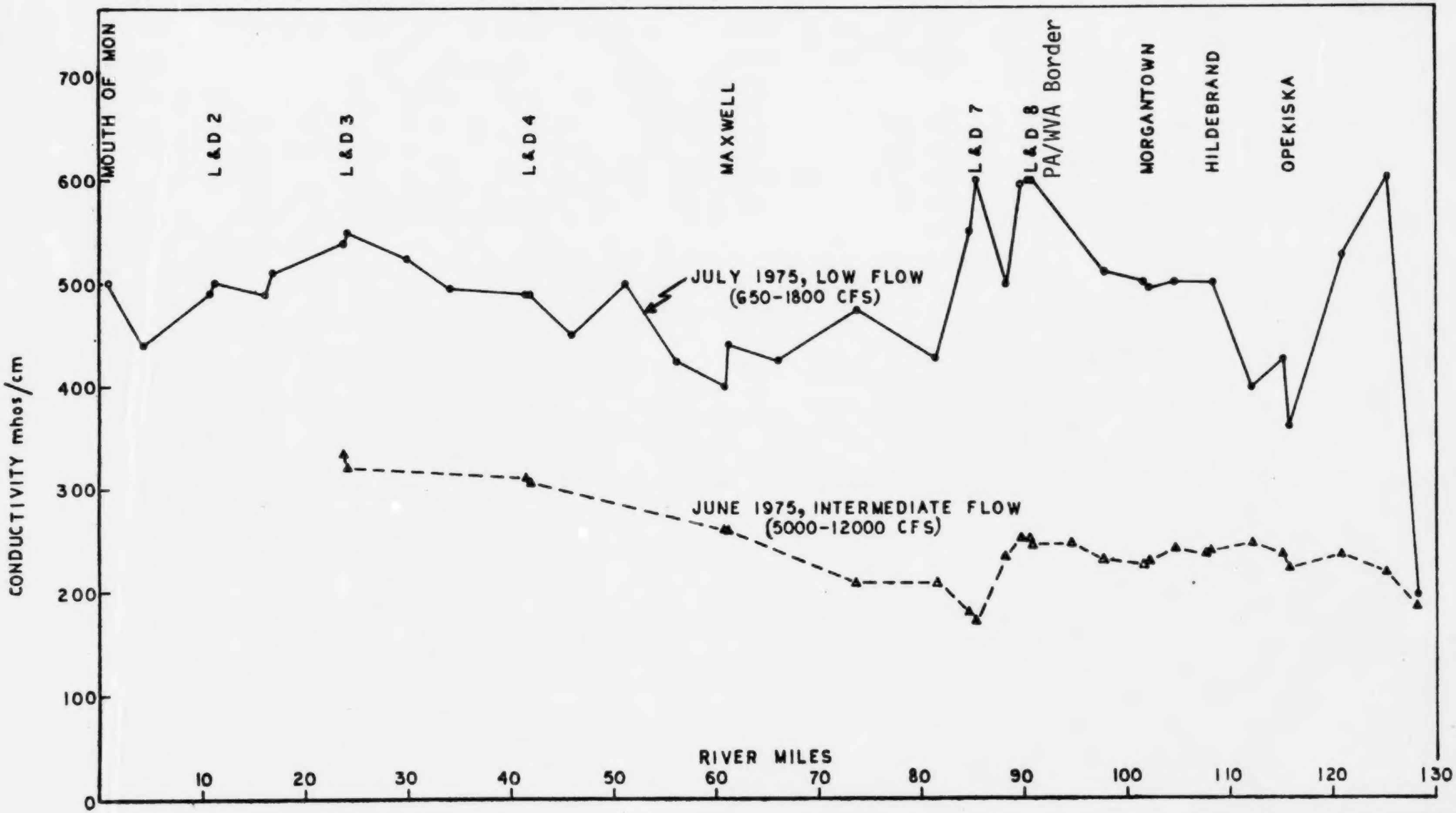


FIGURE 2.1.6.-15 MONONGAHELA RIVER SULFATES (Midstream at one meter depth)

Source (23)

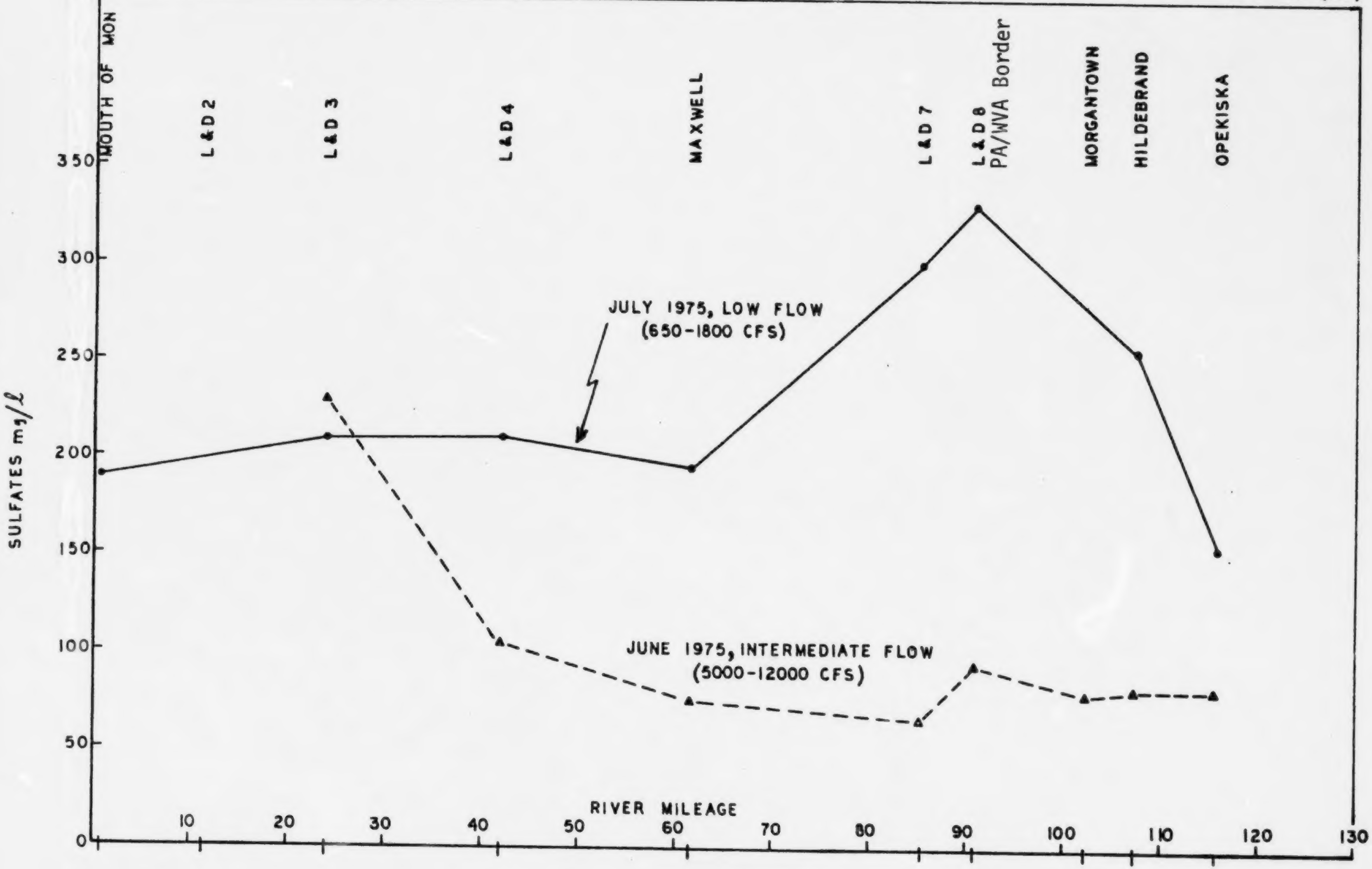


FIGURE 2.1.6.-16 MONONGAHELA RIVER NONFILTRABLE SOLIDS (Midstream at one meter depth) (Source (23)

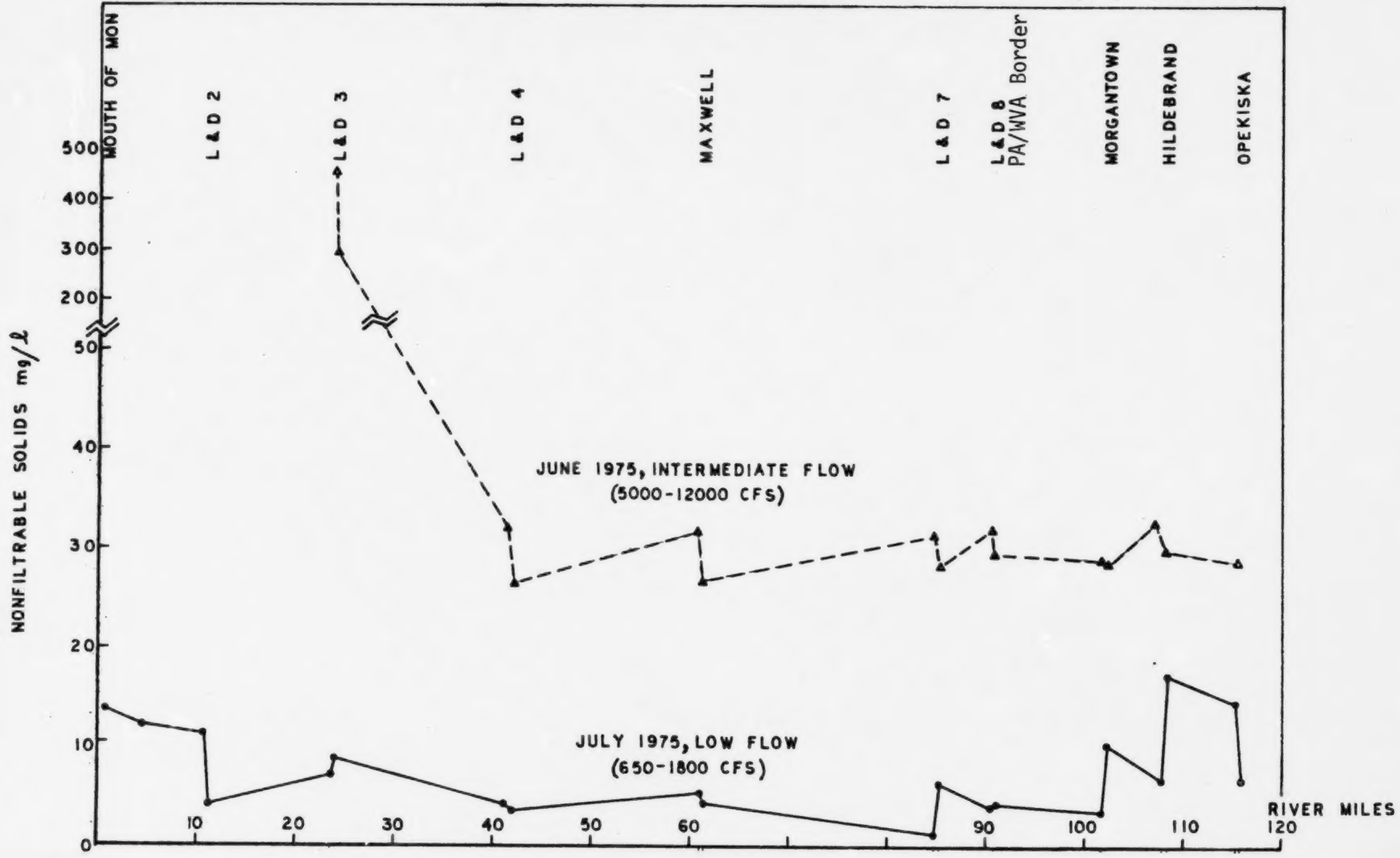


FIGURE 2.1.6.-17 MONONGAHELA RIVER TRANSPARENCY (Midstream)

Source (23)

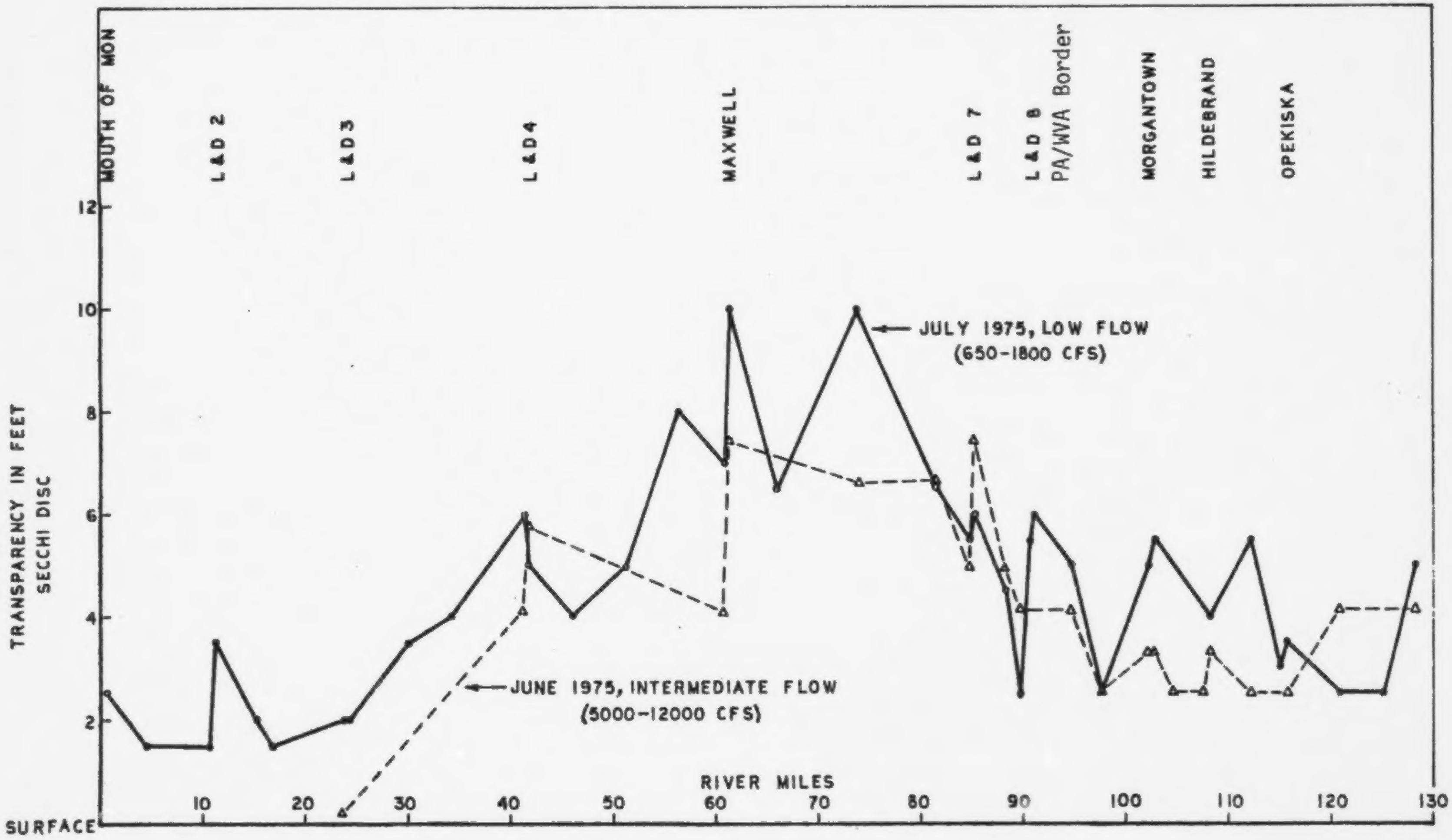


FIGURE 2.1.6.-18 MONONGAHELA RIVER NO_2+NO_3 (midstream at one meter depth) Source (23)

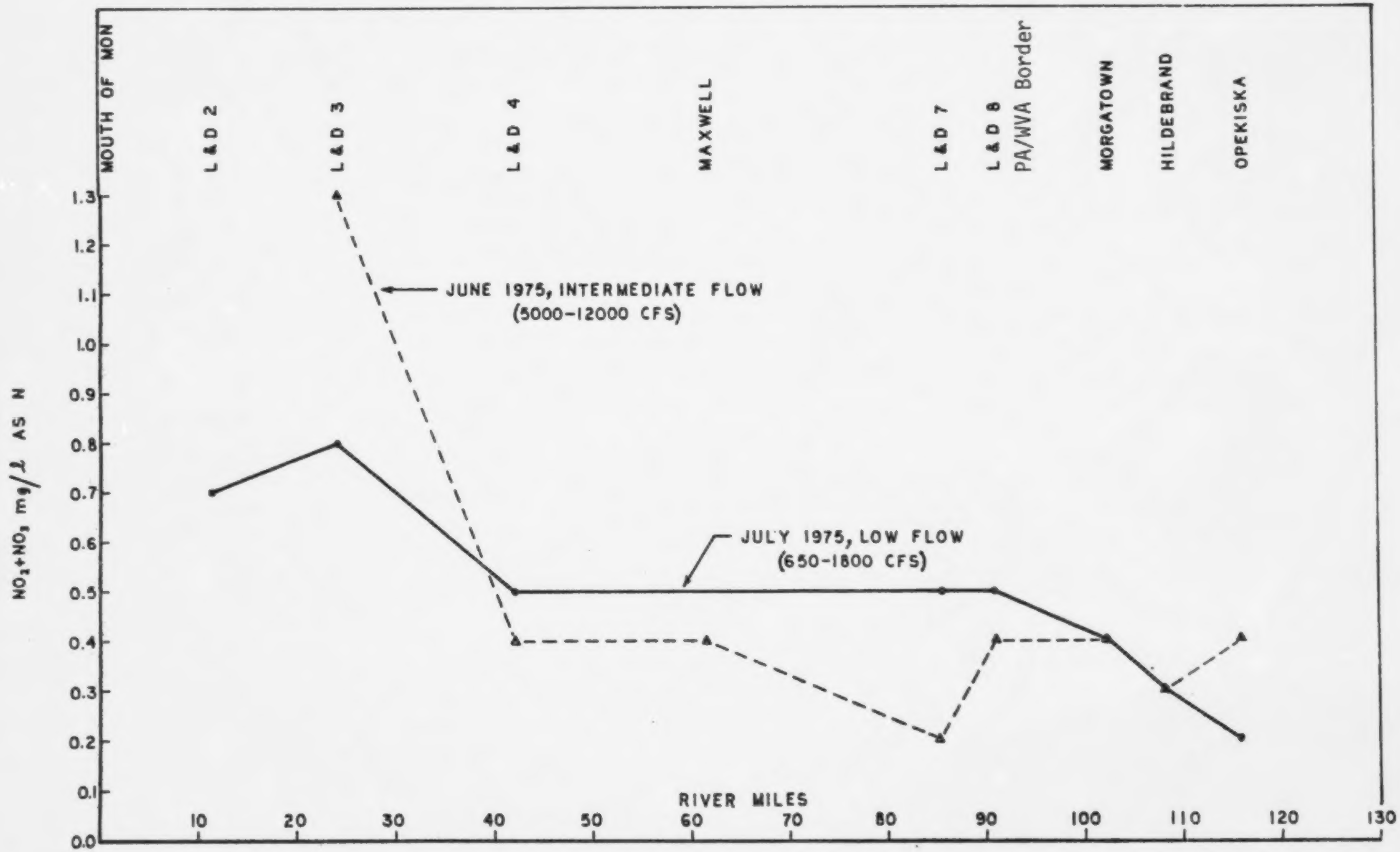


FIGURE 2.1.6.-19 MONONGAHELA RIVER TOTAL IRON (Midstream at one meter depth) Source (23)

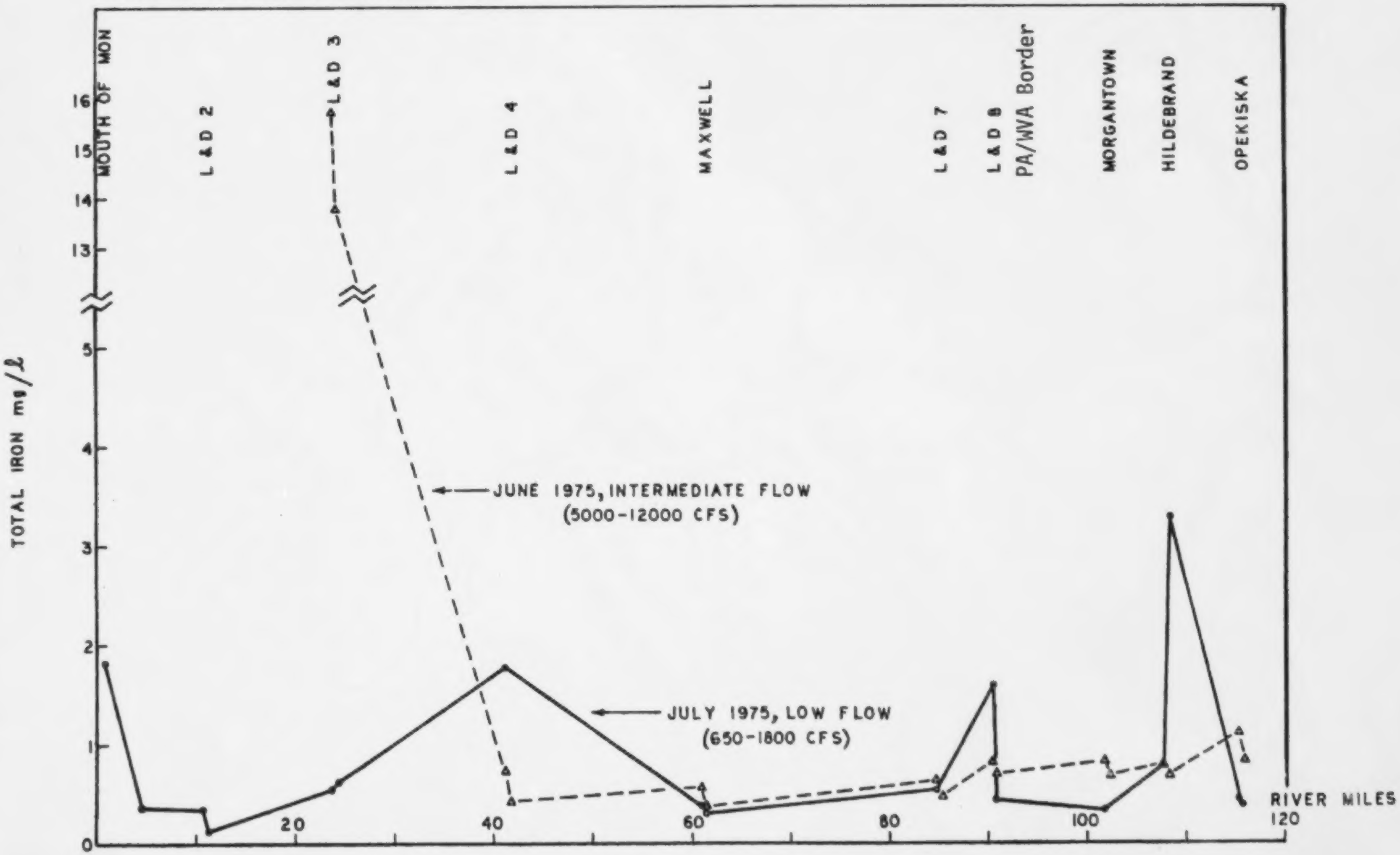


TABLE 2.1.6.-6 Continued

Drainage Area (a)	Stream Name	Location (County)	Segment Limits	Class (b)	Priority Group (c)
W (Cont.)	Raccoon Creek	Beaver, Washington	Burgetts Fork to Ohio River	R	3
	Ohio River	Allegheny, Beaver	Pittsburgh to Ohio/W. Va. Border	MR	3
L(e)	Mosquito Creek	Elk, Clearfield	Headwaters to West Branch Susquehanna River		1A
	West Branch Susquehanna River	Clearfield	Entire length		1A
	S. Branch-Bennett Branch	Clearfield	Headwaters to Bennett Branch		1B
	Chest Creek	Cambria	Headwaters to Rock Run		2
	West Branch Hicks Run	Cameron, Elk	Headwaters to Hicks Run		2
	East Branch Hicks Run	Cameron, Elk	Headwaters to Hicks Run		2
	Hicks Run	Elk	Junction of Branches to Sinnemahoning Creek		2
	Hockenberry Run	Clearfield	Entire length		3
	South Witmer Run	Clearfield	Entire length		3
	North Witmer Run	Clearfield	Entire length		3
	Little Clearfield Creek	Clearfield	Olanta to Clearfield Creek		3
	Stone Run	Clearfield	Entire length		3
	Lick Run	Clearfield	Entire length		3
	Trout Run	Clearfie[illegible]	Entire length		3

TABLE 2.1.6.-6 Continued

Drainage Area(a)	Stream Name	Location (County)	Segment Limits	Class (b)	Priority Group(c)
L (Cont.)	Upper Three Runs	Clearfield	Entire length		3
	Medix Run	Clearfield, Elk	Headwaters to Bennett Branch-Sinnemahoning Creek		3
	Trout Run	Elk	Entire length		3
N(e)	Raystown Branch Juniata River	Somerset	Entire length in County		1B
Z(e)	Wills Creek	Somerset	Entire length in County		3

NOTES:

(a) Refer to Figure 2.1.6.-9 and Table 2.1.6.-4

(b) Class designations:
W = Wild River Areas
S = Scenic River Areas
R = Recreational Rivers
MR= Modified Recreational Rivers

(c) Priority Groups:
1. First priority, statewide or national significance
    1A: First priority, most urgent need for protection
    1B & 1C: First priority, less than immediate concern

2. Second priority, regional significance

3. Third priority, local significance

(d) Crawford, Warren and McKean Counties are not in the ORBES Region

(e) Drainage areas L, N and Z are not in the Ohio River Basin proposed revisions to the "Rules and Regulations" which, among other things, clarify the terminology and format of the Chapter. The definitions of "criteria" and "standard" are: (11)

> Water Quality Criteria - levels of parameters or stream conditions that need to be maintained or attained to prevent or eliminate pollution.
> Water Quality Standards - the combination of water uses to be protected and water quality criteria necessary to protect those uses.

In line with this the proposed revisions are to change the title of Chapter 93 from "Water Quality Criteria" to "Water Quality Standards" and to rescind the chapter in its entirety and substitute a more comprehensive one.

These proposed revisions, although not yet adopted, are probably a more accurate reflection of the standards as they will be applied to the ORBES region in the near future than the existing standards(12) which were last amended in September 1976. Selected information for the proposed chapter is reproduced in the following tables:(11)

Table 2.1.6.-7 defines the words used in describing water quality standards so that there is no confusion in legal interpretation.

Table 2.1.6.-8 updates the uses of water by adding a section on "Special Protection" of high quality waters.

Table 8.1.6.-9 describes the manner in which water quality criteria are applied to the discharge of pollutants, and to the protection of aquatic life. It also distinguishes between general and specific water quality criteria.

Table 2.1.6.-10 details the specific water quality criteria for the parameters by imposing numerical limits.

Table 2,1.6.-11 combines the specific criteria with the designated water use for the major strams in the PA ORBES Region. The list includes the hydrological location and the county of each stream as well as the exceptions to the specific criteria according to the designated water use. The complete list for all streams in Pennsylvania can be found in Reference (11).

TABLE 2.1.6.-7

PROPOSED WATER QUALITY STANDARDS AS OF MARCH 1978: DEFINITIONS

Source (11)

It is recommended that the existing Chapter 93 be rescinded in its entirety and the following substituted in its place.

CHAPTER 93. WATER QUALITY STANDARDS

TABLE OF CONTENTS

Sec.

93.1. Definitions.
93.2. Scope.
93.3. Protested water uses.
93.4. Statewide water uses.
93.5. Application of water quality criteria to discharge of pollutants.
93.6. General water quality criteria.
93.7. Specific water quality criteria.

§ 93.1. Definitions.

The following words and terms, when used in this chapter, shall have the following meanings, unless the context clearly indicates otherwise:

Ambient stream concentration — The natural range in concentration or level of a water quality parameter which would be expected to occur in the absence of human activities; the value is normally determined from quality measurements of waters that are not affected by waste discharges or other human activities.

Ambient temperature — The temperature of the water body upstream of a heated waste discharge or waste discharge complex. The ambient temperature sampling point should be unaffected by any sources of waste heat.

Application factor — A standard factor to be applied to a 96-hour LC50 value to determine a safe concentration value for a pollutant.

Balanced community — An assemblage of various aquatic plant and animal life forms which function as an independent integrated unit which is diverse, including the presence of pollutant-sensitive species and the nondomination of pollutant-tolerant species, and which is self-sustaining.

Carcinogenic — Producing cancer.

Clean Streams Law — The Clean Streams Law (35 P. S. §§ 691.1-691.1001).

Cumulative pollutant — A pollutant which is increased in concentration in an organism by successive additions at different times or in different ways, that is, bioaccumulation.

Effluent limits — Any restriction established by the Department on quantities, rates, and concentrations of pollutants which are discharged into the waters of this Commonwealth.

Epilimnion — Warm upper layer of uniform temperature in a stratified body of water, such as a lake or impoundment.

Federal Water Pollution Control Act — 33 U.S.C.A. §§ 1251-1376.

Minimum daily average — The arithmetic average of all determinations made during a 24-hour period.

Monthly average — The arithmetic average of all determinations made during a calendar month.

Mutagenic — Producing changes in the chromosomes of genes.

96-Hour LC50 value — The concentration of a pollutant in test waters that is lethal to 50% of the test organisms during continuous exposure for a period of 96 hours.

Noncumulative pollutant — A pollutant which is not increased in concentration in an organism by successive additions at different times or in different ways.

Nonpersistent pollutant — A pollutant with a half-life of less than four days in water of quality which is comparable to that of the receiving stream.

Persistent pollutant — A pollutant with a half-life of more than four days in water of quality comparable to the receiving stream.

Representative important species — Those species of aquatic life whose protection and propagation will assure the sustained presence of a balanced community of aquatic life and waterfowl in and on the waters of this Commonwealth. Such species are representative in the sense that maintenance of water quality criteria will assure both the natural completion of the species' life cycles and the overall protection and propagation of the balanced community.

Safe concentration value — A value not exceeding the safe concentration for a pollutant as determined through application of a factor to a 96-hour LC50 value resulting from the standard continuous flow bioassay test.

Teratogenic — Producing monstrosities, malformations, or deviations from the normal structure.

Test water — Distilled carbon filtered deionized water which meets certain quality specifications before reconstituting with specific amounts of various salts so that it approximates the chemical conditions of the receiving waters.

Water quality criteria — Levels of parameters or stream conditions that need to be maintained or attained to prevent or eliminate pollution.

Water quality standards — The combination of water uses to be protected and the water quality criteria necessary to protect those uses.

§ 93.2. Scope.

The provisions of this chapter set forth water quality standards for the waters of this Commonwealth. These standards are based upon water uses which are to be protected and will be considered by the Department in its regulation of discharges.

total iron along the entire Monongahela River at two different flows (one low flow and one intermediate flow) in the summer of 1975. The effect on some of the parameters of the flow in the river as well as the impact of the Cheat and Youghiogheny Rivers is clearly discernible.

Figure 2.1.6.-20 shows the daily variation of Youghiogheny River water temperature at three locations in 1975. The cooling effect of low-flow augmentation from Youghiogheny River Lake is obvious.

The maximum, minimum and mean monthly pH of the Youghiogheny River at Connellsville, PA and the percent of flow at Connellsville contributed by the Casselman River is shown in Figure 2.1.6.-21 from 1953 through 1975. Longitudinal variation of several water quality parameters in April 1974 is shown in Figures 2.1.6.-22 and 2.1.6.-23 for the Casselman River and Laurel Hill Creek, respectively.

3. Water Quality Problems

Table 2.1.6.-14 presents the major quality problems, the courses and miles of streams degraded by those problems in the PA-ORBES Region as compiled from References (2), (25), and (26). The class and category assigned to the streams by DER is also given in the Table. Approximately half of the streams in the basin are beset by the acid mine drainage problem. Most of the rest of the streams are water quality limited and only a few are effluent limited.

The water quality of the main stem of the Monongahela River has deteriorated due to acid mine drainage, inadequately treated sewage, thermal pollution from power plants, and inadequately treated industrial waste. Waterways adversely affected by acid mine drainage include: Turtle Creek, Peters Creek, the main stem of the Youghiogheny River, Jacobs Creek, Jacobs Run, Indian Run, and the Casselman River. Pigeon Creek is affected by sewage discharges. Inadequately treated sewage, together with acid mine drainage, affects the quality in South

FIGURE 2.1.6.-20 YOUGHIOGHENY RIVER WATER TEMPERATURE 1975

Source (24)

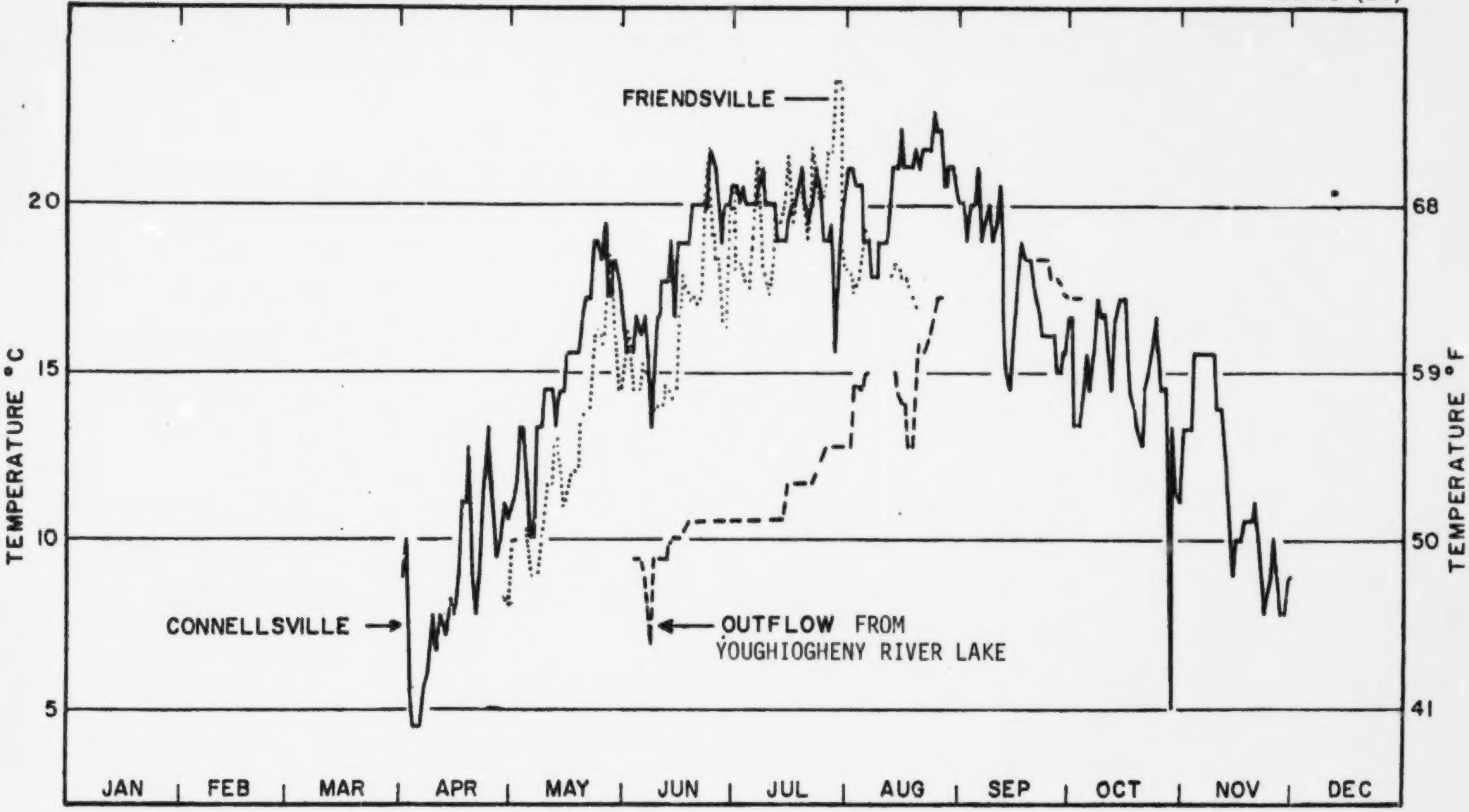
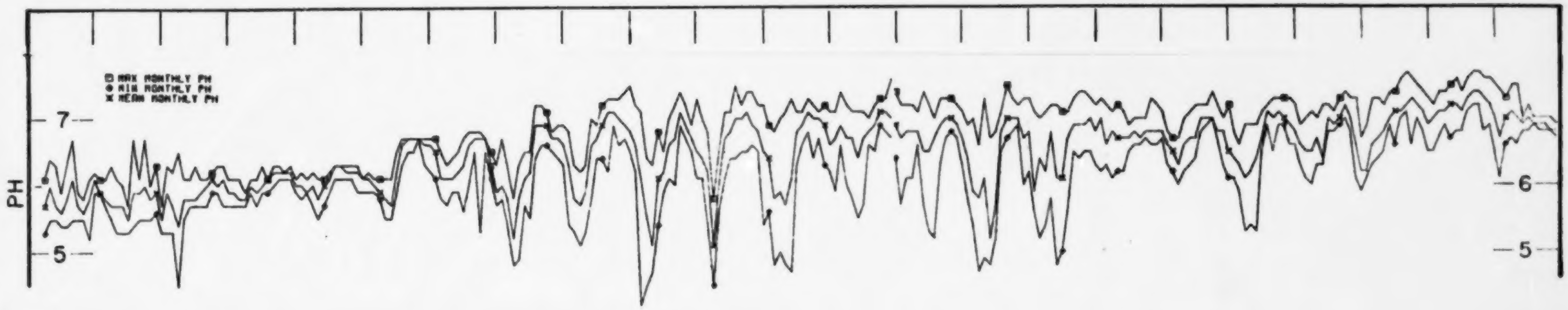


FIGURE 2.1.6.-21

Source (24)

MAXIMUM, MINIMUM, AND MEAN MONTHLY pH OF THE YOUGHIOGHENY RIVER AT CONNELLSVILLE, PA.



THE PERCENT OF FLOW AT CONNELLSVILLE CONTRIBUTED BY THE CASSELMAN RIVER (MARKLETON GAGE)

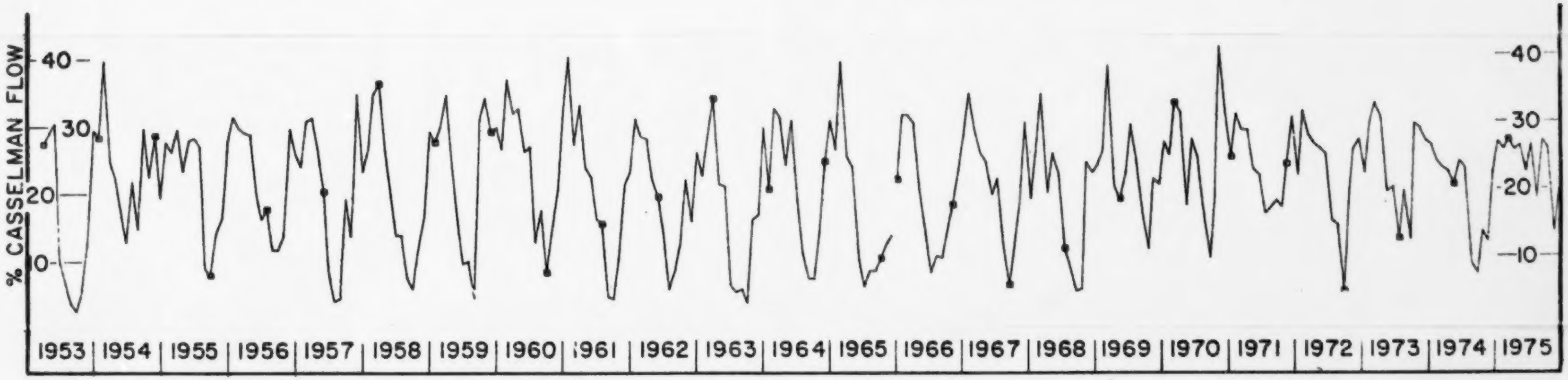


FIGURE 2.1.6.-22 SPATIAL WATER QUALITY PROFILE -- CASSELMAN RIVER, APRIL 1974

Source (3)

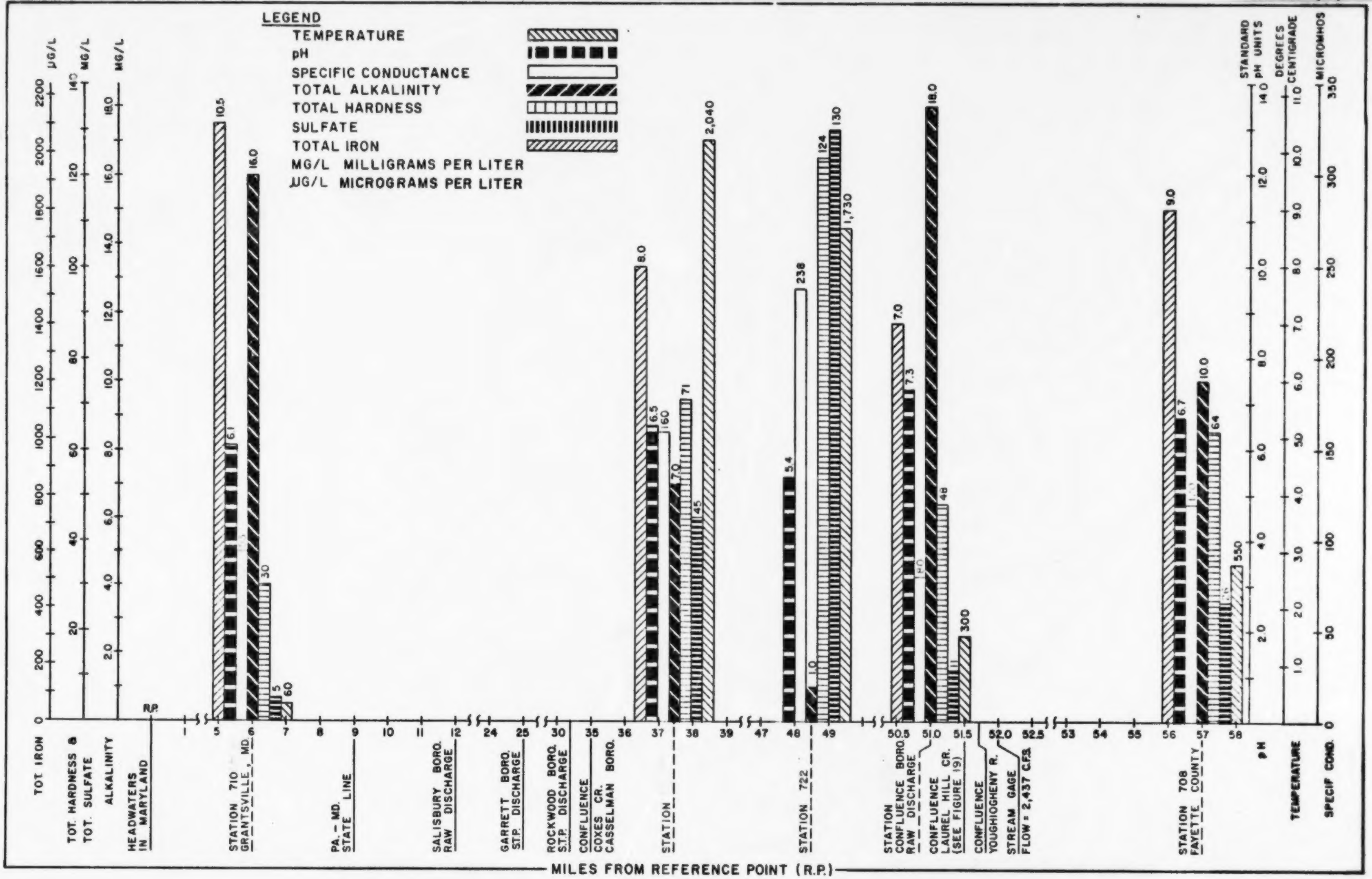


FIGURE 2.1.6.-23 SPATIAL WATER QUALITY PROFILE -- LAUREL HILL CREEK, APRIL 1974

Source (3)

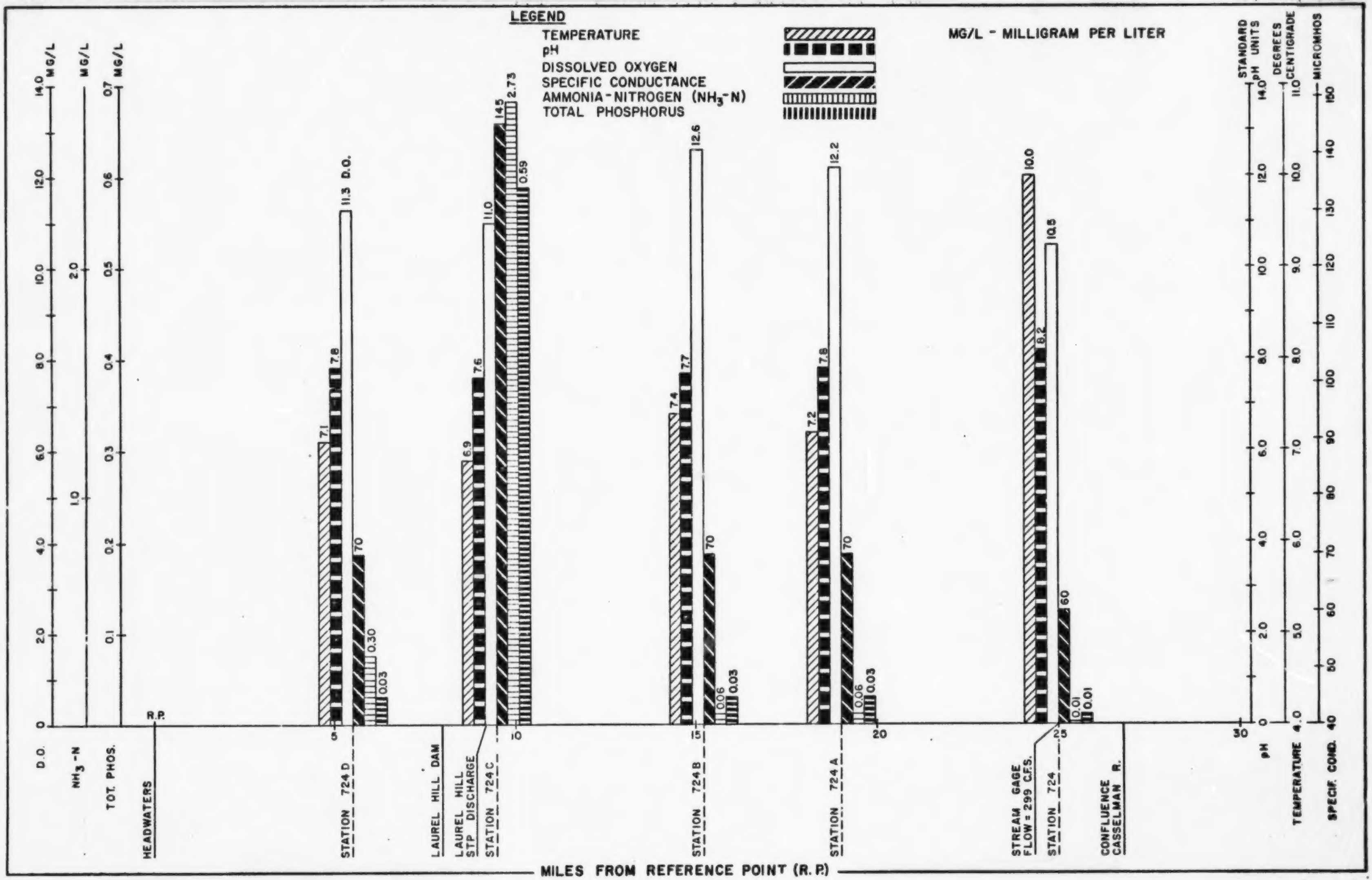


TABLE 2.1.6.-14 CLASSIFICATION AND QUALITY PROBLEMS OF MAJOR STREAMS - MONONGAHELA RIVER BASIN

SOURCES (2), (25), (26)

Stream	Stream Segment	CO-WAMP Sub-Basin	Class (a)	Category (b)	Problems	Causes of Problems (Parameter Group Violation) (c)	Miles of Stream Degraded By Problems
Monongahela River	New Eagle to Point	19A	WQL	I	Cyanide; Oil; Possibly Heavy Metals; Possibly NH_3, Phenols, Iron	Water quality affected by municipal sewage and industrial waste discharges, thermal discharges from power generating plants, acid mine drainage from abandoned mines and urban runoff (1, 2, 3, 4, 5).	15
Turtle Creek		19A	WQL	I	BOD; Suspended Solids; Heavy Metals	Water quality adversely affected by high volumes of acid mine drainage and sewage (1, 2, 3, 4, 5).	30
Thompson Run		19A				Affected by industrial waste in head waters and acid mine drainage throughout the entire length (1, 4, 5).	6
Abers Creek		19A	WQL	I		Inadequately treated sewage	
Youghiogheny River	Sewickley Creek to Mouth	19D	WQL	I		Problems result from sewage, acid mine drainage, industrial wastes from tributaries and urban runoff. Amounts not significant to severely degrade the main stem (1, 2, 3, 4, 5).	12
Sewickley Creek	Main Stem; Buffalo Run to Mouth	19D	AMD	II		Headwaters excellent to Brinker Run; mine drainage enters from this point. Inadequately treated sewage enters from Jacks Run (1, 2, 3, 4, 5).	23
Sewickley Creek	Entire Watershed above and including Buffalo Run	19D	WQL	I	Heavy Metals; Oil		
Little Sewickley Creek		19D				Water quality affected by sewage in Hermine area (2, 3, 4).	3
Youghiogheny River	Watershed above Sewickley Creek	19D	EL	II		Minor problems, acid mine drainage and sewage in tributaries. Amounts not significant to degrade main stem (1, 2, 3, 4, 5).	18
Jacobs Creek	Mt. Pleasant-Scottsdale Area, including Stauffer Run and Sherrick Run	19D	WQL	II	BOD; NH_3; Suspended Solids; Heavy Metals; Oil	Inadequately treated sewage and mine drainage entering from some tributaries (1, 2, 3, 4, 5).	12
Indian Creek	Champion Creek to Mouth	19E	AMD	II		Concentrated mine drainage from deep and strip mines appears to be degrading tributaries (1, 4, 5).	4
Rasler Run	Entire Watershed	19E	AMD	II			
Poplar Run	Entire Watershed	19E	AMD	II			
Champion Creek	Entire Watershed	19E	AMD	II			
Casselman River		19F	AMD	II		Portions degraded due to raw sewage discharges and acid mine drainage (1, 2, 3, 4, 5).	28

TABLE 2.1.6.-14 (Continued)

Stream	Stream Segment	CO-WAMP Sub-Basin	Class (a)	Category (b)	Problems	Causes of Problems (Parameter Group Violation) (c)	Miles of Stream Degraded By Problems
Laurel Hill Creek		19E				Untreated sewerage affects water quality in Jefferson Twp. area. Remainder of the stream is in good to excellent condition (2, 4).	2
Coxes Creek		19F				Water quality degraded due to inadequately treated municipal and industrial wastes and acid mine drainage (1, 2, 3, 4, 5).	3
Peters Creek		19C	WQL	I		High volumes of sewage in main stem, acid mine drainage in some tributaries (1, 2, 3, 4, 5).	6
Monongahela River	Monessen to New Eagle	19C	WQL	I	Cyanide; Oil; Possibly Heavy Metals; Possibly NH_3	Major problems as a result of inadequately treated industrial waste, thermal pollution, sewage and some acid mine drainage (1, 2, 3, 4, 5).	13
Monongahela River	W. Va. Border to Monessen	19 B,C,G	EL	II		Major water quality problem result from mine drainage, inadequately treated raw sewage, thermal pollution and inadequately treated industrial wastes (1, 2, 3, 4, 5).	25
Pigeon Creek	Headwaters to Bentleyville	19C	WQL	I	Iron; Sulfate; BOD; NH_3; Suspended Solids	Problems associated with inadequately treated municipal wastes (2,4).	5
Pike Run		19C				Currently this stream is trout stocked but exhibits minor water quality problems due to untreated sewage and acid mine drainage. Neither is of sufficient quality to degrade the main stem (1, 2, 4, 5).	4
Redstone Creek	Phillips to Mouth	19C	WQL	II	BOD; NH_3; Suspended Solids; Oil	Inadequately treated sewage at Uniontown. Further degradation from acid mine drainage eliminates virtually all stream life (1, 2, 3, 4, 5).	10
Bolden Run	Entire Watershed	19C	AMD	II			
Bute Run	Entire Watershed	19C	AMD	II			
Rankin Run	Entire Watershed	19C	AMD	II			
Redstone Creek	Entire Watershed above Phillips	19C	AMD	II			
Dunlap Creek		19C				Headwater area affected by acid mine drainage and sewage. Recovery occurs near mouth (1, 2, 4, 5).	5
Tenmile Creek	Entire Watershed above South Fork	19B	WQL	II	Suspended Solids; Iron		

TABLE 2.1.6.-14 (Continued)

Stream	Stream Segment	CO-WAMP Sub-Basin	Class (a)	Category (b)	Problems	Causes of Problems (Parameter Group Violation) (c)	Miles of Stream Degraded By Problems
South Fork Tenmile Creek		19B	WQL	II	BOD; NH_3; Suspended Solids	Stream degradation due to inadequately treated and raw sewage and mine drainage from abandoned mines (2, 3, 4).	10
Muddy Run		19B	WQL	II		Inadequately treated sewage, acid mine drainage.	
Little Witley Creek	Main Stem	19B	AMD	II			
Whiteley Creek	Mapletown to Mouth	19G	AMD	II	Suspended Solids	Mine drainage from strip mines and abandoned mines (1, 4, 5).	10
Cats Creek	Entire Watershed	19G	AMD	II			
Jacobs Creek	Entire Watershed	19G	AMD	II			
Georges Creek	York Run to Mouth	19G	AMD	II		Sewage in headwaters, severe acid mine drainage from confluence with York Run to mouth (1, 2, 3, 4, 5).	12
York Run	Entire Watershed	19G	AMD	II			
Dunkard Creek	State Line to Mouth	19G	WQL	II		Stream degradation due to mine drainage, inadequately treated sewage and industrial wastes (1, 2, 4, 5).	10
Cheat River	State Line to Mouth	19G	AMD	II			
Big Sandy Creek		19G	WQL	II			

NOTES:

(a) CLASSES:

WQL = Water Quality Limited Stream
EL = Effluent Limited Stream
AMD = Acid Mine Drainage Affected Stream

(b) CATEGORIES:

See definition in Section 2.1.6.4.

(c) PARAMETER GROUPS:

1 = Harmful substances (heavy metals, chemicals, pesticides, other toxins)
2 = Oxygen depletion
3 = Eutrophication potential (phosphorus, nitrogen)
4 = Physical modification (temperature, turbidity, suspended solids, color, flow)
5 = Salinity, acidity, alkalinity (conductivity, pH, alkalinity, total dissolved solids)

Fork-Tenmile Creek, Muddy Run, Georges Creek, Dunkard Creek, Pike Run, Dunlap Creek and portions of Casselman River, Redstone Creek and Sewickley Creek. Long Run has a siltation problem (27).

4. Compliance Status

Table 2.1.6.-15 presents the 1974 state water quality criteria for the water quality network stations in the Monongahela River Basin along with a comparison of the means and maximum values of the various water quality parameters with those criteria (2). Although the 1974 water quality standards have been recently proposed for revision (see Section 2.1.6.3) and the evaluation may soon be outdated, the Table reveals the major problem areas in complying with the standards. The designation "OK" in Columns (9) through (20) means that the value of the parameter satisfies the water quality criteria for that stream; however, it does not imply that the stream consistently meets water quality criteria. The actual concentrations listed do not meet stream criteria. In addition to the concentrations of the five specific water quality parameters specified for all streams by DER (pH, dissolved oxygen, total iron, temperature, and total dissolved solids), odor and total coliform bacteria, and potential water quality problems are noted.

According to a recent report (29) about half of the Monongahela River Basin's major streams met water quality standards in 1977. Within the basin, however, only about one-sixth of the Turtle Creek watershed met the standards, while over a third of the main stem of the Monongahela and three-quarters of the Youghiogheny, Indian, and Little Sewickley Rivers are satisfactory.

Column (21) summarizes the overall quality rating of the streams by DER and the PA Fish Commission for 1974-75 (26). In Column (22) the water quality conditions are projected to 1983 and the problems which are expected to prevent attainment of the 1983 goals are listed (25). DER estimates that South Fork Tenmile Creek, Pigeon, Peters, and Laurel Hill Creeks will probably meet standards within the next five years.

TABLE 2.1.6.-15 COMPLIANCE STATUS 1975 - MONONGAHELA RIVER BASIN

SOURCES (2), (25), (26)

GENERAL INFORMATION								SPECIFIC WATER QUALITY PARAMETERS							POTENTIAL PROBLEMS						
Station No.	Stream	Class (a)	Category (b)	CO-WAMP Subbasin	County	Criter Stand. Group (c)	Average Flow cfs	pH S.U.	D.O. mg/l	TOT.Fe mg/l	TEMP. oC	TDS mg/l	ODOR S.U.	Total Colif. /100ml	ALL VALUES GIVEN AS mg/l					Overall Quality Rating	Will Stream Meet Water Quality Standards By 1983?
								mean/max.													
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)	(19)	(20)	(21)	(22)
701	Monongahela River	WQL	I	19A	Allegheny	B+h k,q	10,727	OK/ 3.9	OK/.5	2.8/8	OK/40	OK	30/-	31,900/ 633,300	Al 4.2/22	SO_4 OK/540	Tot. Alk. OK/150	Mn OK/2.0		Fair	No. Number and complexity of the municipal and industrial discharges will require considerable time and money in order to meet water quality standards.
702	Monongahela River	WQL	I	19C	Washington	B+h, k,q	8,781	5.3/ 3.5	OK/ 1.2	1.9/ 15.6	OK	OK	27/-	11,200/ 139,200	Al OK/ 23.6	Zn .120/ .200	Ni OK/ .120	SO_4 OK/147	Tot.Alk OK/147	Fair to Poor	No. Lack of funds for mine drainage control projects.
703	Monongahela River	EL	II	19G	Greene	B+h, k,q	5,665	4.7/ 1.3	OK/ 1.8	2.8/ 20	OK	OK	32/ 54	1,500/ 27,000	Phenol .014/ .070	Al OK/5.8	Zn .150/ .150	SO_4 OK/650	Mn OK/2.8	Fair	Do.
704	Turtle Creek	WQL	I	19A	Westmoreland	B-b_2 +b_3	77 (d)													Severely Depressed	No. Some mine drainage affected areas will be restored. However, inadequate funds will prevent complete cleanup.
705	Abers Creek	WQL	I	19A	Allegheny	B-b_2 +b_5	43	OK/ 1.2	OK/ 1.1	2.9/ 50	OK	OK		120,000/ 918,000	Phenol OK/ .050	Ni OK/3.0	SO_4 OK/345	Mn OK/ 2760	Tot.Alk OK/154	Fair	
706	Youghiogheny River	WQL	I	19D	Westmoreland	B	4,556	OK/ 4	OK/ 1.0	2.9/ 8	OK	OK		22,600/ 428,100	Al 3.2/19	Zn OK/.080	SO_4 OK/345	Mn OK/1.7		Fair to Poor	No. Much of the mine drainage will be corrected, but lack of funds will prevent abatement of sewage pollution.

NOTES: (a) Classes: WQL = Water Quality Limited Stream
EL = Effluent Limited Stream
AMD = Acid Mine Drainage Affected Stream
(b) Categories: See definition in text, Section 2.1.6.4.
(c) 1974 Pa. Water Quality Criteria Groups and Levels as defined in Reference (28).
(d) Data Source: USGS Water Resources Bulletin No. 1.
(e) Discontinued.

TABLE 2.1.6.-15 (Continued)

GENERAL INFORMATION								SPECIFIC WATER QUALITY PARAMETERS							POTENTIAL PROBLEMS						
Station No.	Stream	Class (a)	Category (b)	CO-WAMP Subbasin	County	Criter Stand. Group (c)	Average Flow cfs	pH S.U.	D.O. mg/l	TOT.Fe mg/l	TEMP. oC	TDS mg/l	ODOR S.U.	Total Colif. /100ml	ALL VALUES GIVEN AS mg/l					Overall Quality Rating	Will Stream Meet Water Quality Standards By 1983?
								mean/max.													
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)	(19)	(20)	(21)	(22)
707	Youghiogheny River	EL	II	19D	Fayette	B	2439	OK/ 5.5	OK	OK/6	OK	OK		6000/ 70000	Phenol OK/26	Al 2.7/27				Marginally acid.	Do.
708 (e)	Youghiogheny River	EL	II	19E	Fayette	A	1828	OK/ 5.1	OK	OK/ 8.0	OK	OK		4800/ 46000	SO_4 OK/675					Good	Do.
710	Casselman River			19F	Somerset																No. Lack of funds for mine drainage control projects and sewage treatment plants.
712	Redstone Creek	WQL	II	19C	Fayette	B+V_2	223	OK/ 5.2	3.5/ 0	58/ 200	OK	826/ 2538		97400/ 443300	Phenol .300/ 1.400 NH_3-N OK/3.1	Al OK/3.9	Zn .056/ .060	Ni .270/ .360	SO_4 880/ 2150	Poor.	No. Lack of funds under 92-500 will prevent construction of necessary sewerage facilities.
713	South Fork Tenmile Creek	WQL	II	19B	Greene	B+V_2	222	OK/ 8.8	OK/ 2.0	1.6/ 32	OK/31	OK		34900/ 534200	Phenol .022/ .040	Al 4.3/ 1.8	Zn .060/ .090	SO_4 OK/720	Tot.Alk OK/185	Good to Excellent.	Yes.
714	Dunkard Creek	WQL	II	19G	Greene	B	303	5.1/ 2.8	OK/ 1.4	31.4/ 200	OK	OK/ 1066		1800/ 28500	Al 18.3 /.320	Zn .275/ .460	Ni .210/ .330	SO_4 656/ 2800	Mn 3.1/ 60	Fair to Good. Depressed downstream.	No. Lack of funds for mine acid control projects.
715	Sewickley Creek	WQL	I	19D	Westmoreland	B	289	OK/ 3.9	OK/ 1.0	12.3/ 34.	OK	OK/ 1096		139800/ 591100	Al OK/ 2.3	Zn .050/ .090	Ni .100/ .140	SO_4 300/ 695	Mn 1.1/ 3.6	Excellent head waters, poor below headwaters.	No. Much of the mine drainage will be corrected. Lack of funds will prevent complete cleanup.

NOTES: (a) Classes: WQL = Water Quality Limited Stream
EL = Effluent Limited Stream
AMD = Acid Mine Drainage Affected Stream

(b) Categories: See definition in text, Section 2.1.6.4.
(c) 1974 Pa. Water Quality Criteria Groups and Levels as defined in Reference (28).
(d) Data Source: USGS Water Resources Bulletin No. 1.
(e) Discontinued.

TABLE 2.1.6.-15 (Continued)

GENERAL INFORMATION								SPECIFIC WATER QUALITY PARAMETERS							POTENTIAL PROBLEMS						
Station No.	Stream	Class (a)	Category (b)	CO-WAMP Subbasin	County	Criter Stand. Group (c)	Average Flow cfs	pH S.U.	D.O. mg/1	TOT.Fe mg/1	TEMP. °C	TDS mg/1	ODOR S.U.	Total Colif. /100ml	ALL VALUES GIVEN AS mg/1					Overall Quality Rating	Will Stream Meet Water Quality Standards By 1983?
								mean/max.													
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)	(19)	(20)	(21)	(22)
716 (e)	South Fork Tenmile Creek	WQL	II	19B	Greene	B+V_2	203 (d)	OK	OK	OK	OK	OK			Al OK/1.9	SO_4 OK/410	Tot.Alk. OK/174			Good	Yes.
717	Ten Mile Creek	WQL	II	19B	Washington	C+V_2		OK	OK	OK	OK	OK			SO_4 OK/182	Cl OK/235	Tot.Alk OK/156	NH_3-N OK/3.3		Good to Excellent.	
718	Pigeon Creek	WQL	I	19C	Washington	C+V_2	4 (d)	OK	OK	OK/2.4	OK	OK			Zn .200/.200	Ni .510/.510	SO_4 1151/4095	Tot. Alk. 171/336	Mn 5.5/5.5 NH_3-N OK/2.0	Marginal to Poor.	Yes.
719	Peters Creek	WQL	I	19C	Allegheny	B-b_2 +b_5	54 (d)	OK	OK	OK/2.7	OK	OK			Zn .140/.140	SO_4 477/858	Mn 1.1/1.1			Depressed.	Yes.
720 (e)	Turtle Creek	WQL	I	19A	Westmoreland	B-b_2 +b_5	-	4.5/4.5	OK	22.1/50	OK	OK			SO_4 294/408					Poor	No. Some mine drainage-affected areas will be restored. However, inadequate funds will prevent complete cleanup.
721	Jacobs Creek	WQL	II	19D	Westmoreland	C+V_2	11	OK	OK	OK	OK	OK			Zn .100/.160	SO_4 OK/528	Mn OK/1.6			Severely Depressed Upstream. Fair Downstream.	No. Mine drainage problem will not be corrected due to lack of funds.
723	Big Sandy Creek	WQL	II	19G	Fayette	A	-	OK	OK	OK	OK/21	-	-	-	Zn.123/320					Excellent.	
724	Laurel Hill Creek			19E	Somerset																Yes.
725	Mononga River	EL	II	19G	Greene	B+h,k,q	4494 (d)													Fair.	No. Lack of funds for mine drainage control projects.

NOTES: (a) Classes: WQL = Water Quality Limited Stream
EL = Effluent Limited Stream
AMD = Acid Mine Drainage Affected Stream
(b) Categories: See definition in text, Section 2.1.6.4.
(c) 1974 Pa. Water Quality Criteria Groups and Levels as defined in Reference (28).
(d) Data Source: USGS Water Resources Bulletin No. 1.
(e) Discontinued.

ORSANCO recently assessed the water quality of the Ohio River main stem and its tributaries by comparing the data collected at its monitoring stations during the year July 1, 1975 - June 30, 1976 with ORSANCO's stream quality criteria (or with ORBC's criteria for the parameters lacking ORSANCO criteria). The parameters found to have exceeded those criteria at South Pittsburgh on the Monongahela River are listed below (37).

Parameter	Dissolved Oxygen	Total Suspended Solids	Fecal Coliforms for		Total Phosphorus	Cyanide	Iron
			Recreation	Water Supply			
% of Samples (or time) Exceeding ORSANCO/ORBC Criteria in 1975-76	3	7	100	63	20	62	29

Acid mine drainage, affecting many of the streams in the basin will not be brought under control within the foreseeable future due to insufficient funds available. The following waters are so polluted by abandoned mines that implementation of some effluent limitations to meet water quality standards has been postponed (35).

Stream Name	County
Thompson Run	Allegheny
Indian Creek from Champion to mouth	Fayette
Raspler Run	Fayette
Poplar Run	Fayette
Maple Creek	Washington
Bolden Run	Fayette
Bute Run	Fayette
Rankin Run	Fayette
Browns Run	Fayette
Little Whitely Creek	Greene
Whitely Creek from Mapleton to mouth	Greene
Cats Creek	Fayette
Jacobs Creek near Masontown	Fayette
Georges Creek from York Run to mouth	Fayette
York Run	Fayette
Dunkard Creek from state line to mouth	Greene
Cheat River	Fayette

5. Stream Quality Changes, 1973-1977

The Bureau of Water Quality Management, PA DER, bi-annually reports the recorded improvements and degradations in water quality. Table 2.1.6.-16 presents the improved lengths and Table 2.1.6.-17 the degraded length of the various streams in the Monongahela River Basin for the last five years (25).

In a recent study, ORSANCO evaluated the possible short-term trends in water quality parameters by comparing the 1964-75 data base with the July 1, 1975 - June 30, 1976 data at its monitoring stations (37). The results of the trend analysis at Charleroi on the Monongahela River are summarized below.

Parameter	Dissolved Oxygen	Water Temperature	pH	Turbidity	Spec. Cond.	Total Hardness
Trend	Increasing	Increasing	Increasing	No Statistically Significant Trend	Decreasing	
Level of Signific.	0.05	0.05	0.001		0.05	

TABLE 2.1.6.-16

STREAMS SHOWING WATER QUALITY IMPROVEMENTS (1973-1977)-
MONONGAHELA RIVER BASIN
Source (25)

Year	Stream	County	Length Improved Miles	Reason for Improvement
1974	Jacobs Creek	Westmoreland	1	Improved industrial waste treatment
	Monongahela River	Greene Fayette Washington Westmoreland Allegheny	75	Mine drainage abatement
	South Branch Muddy Creek	Greene	0.5	Improved sewage treatment
	Sugar Run	Greene	0.5	Industrial waste treatment
1975	Youghiogheny River	Somerset	1	Sewage treatment
	Pollock Run	Westmoreland	5	Sewage treatment
	Monongahela River	Greene and Fayette	12	Mine drainage abatement
	Youghiogheny River	Westmoreland	1	Improved sewage treatment
	Unnamed Tributary of Turtle Creek	Allegheny	1	Elimination of siltation problem
	Unnamed Tributary to Peters Creek	Allegheny	2	Improved sewage treatment
1976	Monongahela River	Washington Fayette Westmoreland Allegheny	9	Industrial waste treatment
	Monongahela River	Allegheny	2	Improved sewage treatment
	Youghiogheny River	Westmoreland	1.5	Sewage treatment
	Long Run	Westmoreland and Allegheny	1	Sewage treatment
	Slate Run	Westmoreland	3	Sewage treatment
	Whitely Creek	Greene	7	Erosion control
	Muddy Creek	Greene	3.5	Sewage treatment
	Redstone Creek	Fayette	2.5	Removal of trash and debris
	Sewickley Creek	Westmoreland	1	Improved industrial waste treatment

TABLE 2.1.6.-17

STREAMS SHOWING WATER QUALITY DEGRADATION (1973-1977) — MONONGAHELA RIVER BASIN
Source (25)

Year	Stream	County	Length Degraded Miles	Reasons for Degradation
1975	Sewickley Creek	Westmoreland	1.5	Abandoned mine breakout
1976	Rasler Run	Fayette	4	Mine drainage
	Brush Run (Jacobs Creek)	Westmoreland	3	Surface mine drainage
	Little Pike Run	Washington	1	Mine drainage

B. Allegheny River Basin

1. General

The concentration of dissolved solids in the Allegheny River mainstem was reported in 1956 to vary in an opposing manner to what is generally expected. The relatively high concentration in the upstream region tended to decrease downstream toward Kittanning, Pennsylvania. This was due to the brine from the oil fields raising the sodium chloride content of the water in the Upper Allegheny River Basin and the resulting high concentrations diluted by water from other areas in the Middle and Lower Basins. Below Kittanning additional changes in the chemical character of the river water were brought about by acid mine drainage intorudced by the tributaries, especially the Kiskiminetas River: bicarbonate disappeared, sulfate content increased, and the pH dropped to acid condition (30).

In addition to acid mine drainage, which is still the most serious pollutant reaching the river, other forms of pollution from municipalities and industries resulted in further degradation of the Allegheny River quality in its Middle and Lower Basins. Shapiro et al. reported that the following pollutants were added in significant amounts in 1964-65: accidity, hardness, calcium, sulfates, iron, manganese, sodium, chlorides, phenol, total solids, and BOD (17).

The greatest portion of acidity, sulfates, iron, manganese, and hardness is contributed by the Kiskiminetas drainage area. To reduce the impact of these components on the Allegheny River, low-flow augmentation is provided by the Corps of Engineers from Allegheny Reservoir at Kinzua since 1967. Releases from the reservoir are coordinated not only with streamflow of the Allegheny River (to provide a contemplated minimum regulated flow of 1,000 cfs at Franklin and 2,000 cfs at Natrona) but also with its water quality, monitored at four stations in the basin (31). This low-flow augmentation for quality control is especially valuable to counteract slugs of acid mine waste from the Kiskiminetas drainage basin. These slugs, produced by heavy rainfall in the basin, are detained in the Conemaugh and Loyalhanna flood control reservoirs until increased flows from the Allegheny Reservoir can reach the confluence of the Kiskiminetas River to provide dilution water. The augmented flow also helps to mitigate the taste and odor problems primarily caused by the organic loading from Oil Creek, French Creek, and the Clarion River (32).

Another reservoir in the Allegheny River Basin operated for low-flow augmentation is the East Branch Clarion Reservoir. Its main purpose is to prevent septic conditions in the main stem of Clarion River between Johnsonburg and Ridgway during periods of low flow. Its beneficial effect, however, extends further downstream by providing dilution and neutralization of the acid Clarion and Kiskiminetas Rivers (33).

With increasing control of waste effluents from manufacturing plants, municipalities, and active mines, acid mine drainage from abondoned mines will continue to be a problem. Also, the large concentrations of fecal bacteria reaching Pittsburgh indicate a future problem, even after the acidity and other problems are alleviated (34).

2. Surface Water Quality

Figure 2.1.6.-24 shows the yearly averages and ranges of water temperature, conductivity, dissolved oxygen, and pH for the Allegheny River at Oakmont as calculated from ORSANCO'S Robot Minitor data. The figure indicates generally good dissolved oxygen levels, improving pH and slightly rising temperatures during 1970 through 1977. Figure 2.1.6.-25 shows the range and mean of monthly averages for the same parameters at Oakmont. The summer is the critical period for all four parameters: temperature and conductivity reach maxima,

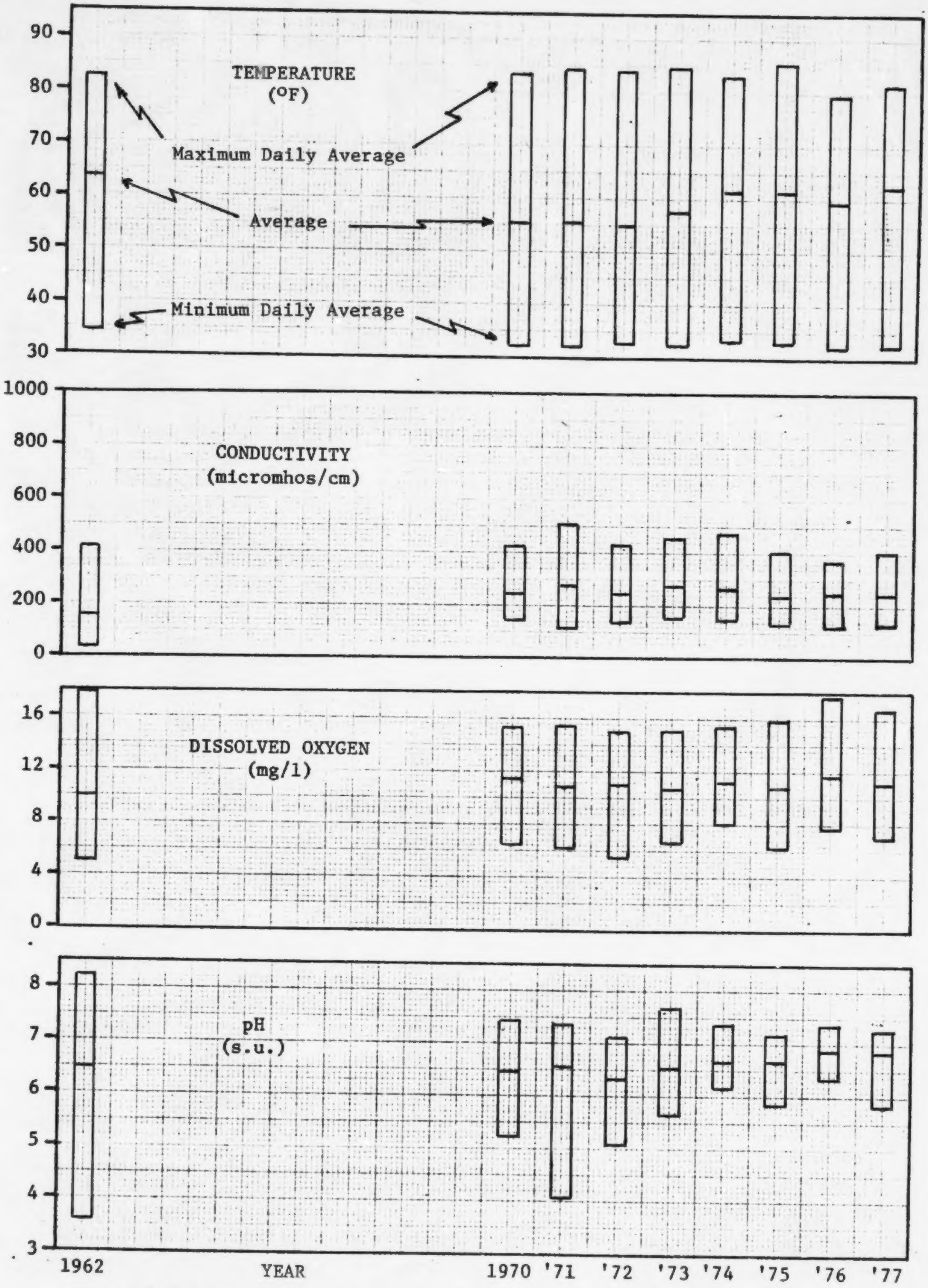


FIGURE 2.1.6.-24 ANNUAL WATER QUALITY -- ALLEGHENY RIVER AT OAKMONT (6)

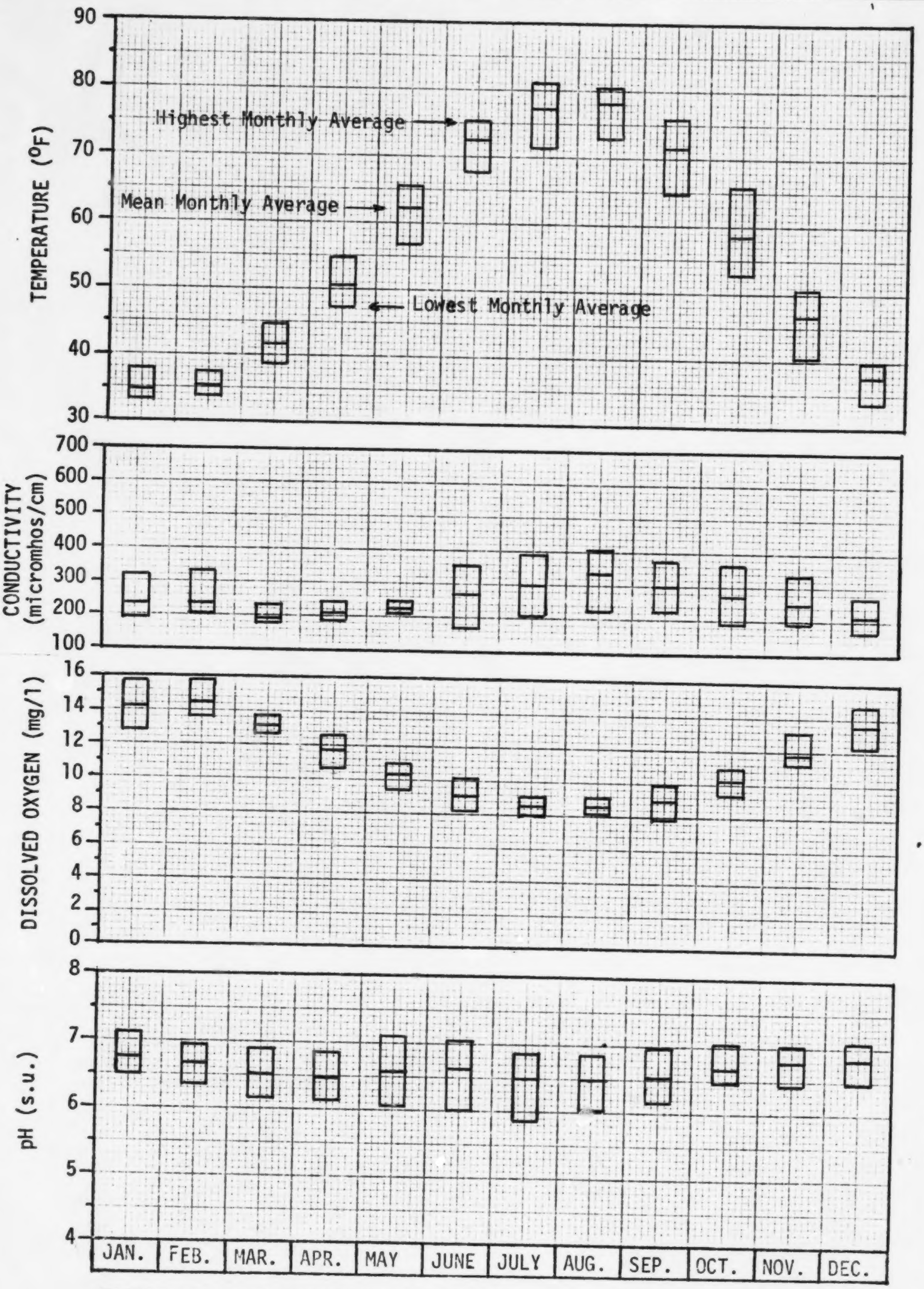


FIGURE 2.1.6.-25 SEASONAL VARIATION OF WATER QUALITY: MONTHLY AVERAGES - ALLEGHENY RIVER AT OAKMONT, 1970-77 After Source (6)

dissolved oxygen and pH reach minima during the warm weather period. Both figures were derived from ORSANCO'S Robot Monitor data (6).

Tables 2.1.6.-18 and 2.1.6.-19 give twelve-year means of selected parameters at a number of Water Quality Network Stations in the Upper, Middle, and Lower Allegheny River Basins (1), (2). Mean, maximum, and minimum values of most parameters sampled at selected stations in the Allegheny River Basin are presented in Table 2.1.6.-20 for the 1972-73 period and in Table 2.1.6.-21 and 2.1.6.-22 for the 1975-77 period, as derived from the STORET System.

The longitudinal variation of a few major water quality parameters in the Little Conemaugh/Conemaugh Rivers and Stony Creek is illustrated in Figures 2.1.6.-26 and 2.1.6.-27, respectively. Figure 2.1.6.-28 shows the time variation of major parameters at Station 811 in the Conemaugh River between January 1970 and December 1974 (3).

3. Water Quality Problems

The major water quality problems in the Allegheny River Basin are presented in Table 2.1.6.-23, along with the DER-assigned classes and categories as extracted from References (1), (2), (25), and (26).

Acid mine drainage is the major cause of water quality problems in the Basin, especially in the Clarion, Conemaugh, and Kiskiminetas watersheds where many streams suffer from low pH and high concentrations of free sulfuric acid, sulfate, and metals such as iron, aluminum, manganese, nickel, and zinc. The streams degraded by acid mine drainage are classed AMD in the Table.

Inadequately treated or raw (the latter mostly originating from malfunctioning on-lot waste disposal systems) municipal and industrial waste discharges cause additional problems, particularly in the Upper and Middle Basins. Redbank Creek near Reynoldsville, Brookville and New Bethlehem,

TABLE 2.1.6.-18

MEAN VALUES OF SELECTED PARAMETERS AT SAMPLING
STATIONS IN THE UPPER ALLEGHENY RIVER BASIN
(Data Collected from May 1962 to December 1974)
Source (1)

Parameter	Stream						
	Allegheny River		French Creek	Tionesta Creek		French Creek	Tionesta Creek
	Sampling Station (PA-DER WQN No.)						
	804	805	826	829	830	845	853
pH (S.U.)	6.9	7.0	6.8	6.6	6.7	7.7	6.7
Dissolved Oxygen (mg/1)	10.0	10.2	9.8	10.7	10.7	10.1	8.5
Total Iron (ug/1)	795	457	1,000	438	490	883	379
Total Dissolved Solids (mg/1)	132	92	120	58	56	154	76
Temperature (^{o}C)	ND	10.7	11.5	11.5	11.7	25.9	23.2
Turbidity (JTU)	12.5	11.0	12.9	6.6	6.8	7.6	3.4
Ammonia (mg/1 N)	0.15	0.13	0.33	0.14	0.10	0.14	0.13
Total Phosphorus (mg/1 P)	0.07	0.06	0.1	0.04	0.04	0.07	0.02
Alkalinity (as $CaCO_3$) (mg/1)	53.7	50.6	74.5	19.8	22.3	61.5	18.1
Biochemical Oxygen Demand (mg/1)	2.2	1.7	2.1	1.7	1.6	ND	ND
Total Coliform (#/100 ml)	59,000	12,000	28,000	1,200	34,800	ND	ND

TABLE 2.1.6.-19

MEAN VALUES OF SELECTED PARAMETERS AT SAMPLING
STATIONS IN THE MIDDLE AND LOWER ALLEGHENY RIVER BASINS
(Data collected from June 1962 to December 1974)

Source (2)

	Stream								
	Allegheny River			Clarion River		West Branch Clarion River	East Branch Clarion River	Clarion River	
	Sampling Station (PA-DER WQN No.)								
Parameter	801	802	803	821	823	824	825	833	843
pH (S.U.)	6.7	7.1	7.3	5.2	6.2	6.6	5.2	5.3	5.6
Dissolved Oxygen (mg/1)	10.2	10.8	10.5	9.0	8.9	10.7	10.9	8.2	8.1
Total Iron (ug/1)	4,975	646	1,008	735	452	375	329	395	741
Total Dissolved Solids (mg/1)	24	11	61	113	91	74	61	63	228
Temperature (°C)	10.9	12.8	11.5	12.0	13.5	10.7	11.4	12.4	24.8
Turbidity (JTU)	13.6	11.7	11.8	8.3	18.9	5.7	5.0	7.5	4.5
Ammonia (mg/1 N)	0.27	0.23	0.14	0.18	0.15	0.08	0.9	0.25	0.15
Total Phosphorus (mg/1 P)	0.04	0.05	0.12	0.05	0.05	0.02	0.02	0.06	0.02
Alkalinity (as $CaCO_3$) (mg/1)	19.8	37.9	41.3	9.8	19.0	25.8	6.1	22.6	6.5
Biochemical Oxygen Demand (mg/1)	2.0	2.0	1.9	1.4	13.1	1.7	1.4	2.6	ND
Total Coliform (#/100 ml)	12,300	7,800	32,600	300	133,600	61,500	8	29,800	ND

TABLE 2.1.6.-20

ALLEGHENY RIVER WATER QUALITY (from EPA STORET System)

Source (34)

Parameter	Pittsburgh, Pennsylvania 4/4/72 to 12/17/73				Kittanning, Pennsylvania 9/14/72 to 9/24/74			
	Number of Samples	Mean Value	Maximum Value	Minimum Value	Number of Samples	Mean Value	Maximum Value	Minimum Value
Water Temperature, °C	15	14.6	25.0	0.5	7	16.4	28	4
Flow, cfs	13	14,563.1	52,400	4,500	2	14,500	15,000	14,000
Turbidity, JTU	12	8.9	35.0	1.0	8	8.7	33	05
Threshold Odor Number at 60°C	3	0	0	0	--	------	---	---
Conductivity at 25°C, micromhos/cm	15	328.5	440.0	250.0	7	244.4	600	150
Dissolved Oxygen, mg/l	15	9.7	11.6	7.0	7	9.9	12.4	79
Biochemical Oxygen Demand, 5 day, mg/l	15	1.8	2.8	1.0	1	1.6	1.6	16
pH, units	15	6.7	7.4	6.3	8	7.0	7.4	65
Total Alkalinity, mg/l as $CaCO_3$	12	17.2	25	13	8	51.6	212	15
Total Acidity, mg/l $CaCO_3$	12	3.4	9	0	--	-------	-----	-----
Total Filtered Residue, mg/l	12	181.2	236	147	1	162	162	162
Ammonia Nitrogen, mg/l	14	0.3	0.8	0.1	8	0.25	1.4	0
Nitrate Nitrogen, mg/l	12	0.5	0.8	0.3	8	0.46	0.9	02
Total Phosphorus, mg/l	12	0.07	0.12	0.03	8	0.05	0.12	0
Orthophosphate, mg/l	12	0.04	0.06	0.02	--	------	------	----
Oil and Grease, mg/l	5	22.4	37.6	2.6	--	------	------	----
Total Organic Carbon, mg/l	15	2.9	8.0	1.0	--	------	------	----
Total Hardness, Mg/l as $CaCO_3$	12	103.8	148	60	8	77	93	58
Chloride, mg/l	12	15.9	43	7	8	13	18	4
Sulfate, mg/l	12	86.3	145	40	8	46.6	82	21
Dissolved Fluoride, mg/l	12	0.2	0.4	0.1	--	---	---	--
Cyanide, mg/l	15	0.003	0.01	0.0	--	---	---	--
Total Arsenic, mg/l	8	.002	.005	0	--	---	---	--
Total Cadmium, mg/l	7	.001	.004	0	2	0.004	0.005	0.003
Total Chromium, mg/l	7	.001	.003	0	2	0.05	0.09	0.01
Total Copper, mg/l	8	0.006	.01	0	2	0.055	0.08	0.03
Total Iron, mg/l	11	0.9	3.6*	0.13	8	0.822	2.70*	0.160
Total Manganese, mg/l	10	0.7	1.5*	0.5	9	0.331	0.61	0.033
Total Lead, mg/l	7	0.012	0.055	0	2	0.05	0.05	0.05
Total Zinc, mg/l	8	0.097	0.176	0.044	2	0.035	0.04	0.03
Mercury, mg/l	----	-----	-----	---	--	-----	-----	----
Total Coliforms, No/100 ml	12	6,783	63,000	500	--	-----	-----	----
Fecal Coliforms, No/100 ml	12	908*	4,500	16	--	-----	-----	----
Phenols, mg/l	15	0.027	0.035	0	--	-----	-----	----

* Exceeds the state's specific water quality criteria

TABLE 2.1.6.-20 (Continued)

Parameter	New Kensington, Pennsylvania 7-18-72 to 10-4-74			
	Number of Samples	Mean Value	Maximum Value	Minimum Value
Water Temperature, $^{\circ}C$	9	13.3	25	0.5
Flow, cfs	8	22,240	51,500	5740
Turbidity, JTU	3	1.3	3.0	0.5
Conductivity at $25^{\circ}C$, micromhos/cm	8	230.7	348	130
Dissolved Oxygen, mg/l	8	11.3	17.5	7.8
Biochemical Oxygen Demand, 5 day, mg/l	1	1.0	1.0	1.0
pH, units	9	6.5	6.7	6.2
Total Alkalinity, mg/l as $CaCO_3$	8	12.9	30	6
Total Acidity, mg/l $CaCO_3$	2	9.5	17	2
Total Filtered Residue, mg/l	1	298	298	298
Ammonia Nitrogen, mg/l	2	0.28	0.3	0.25
Nitrate Nitrogen, mg/l	3	1.3	2.8	0.4
Total Phosphorus, mg/l	2	0.05	0.07	0.02
Total Organic Carbon, mg/l	6	4.0	6.5	3.0
Total Hardness, mg/l as $CaCO_3$	3	100	118	84
Chloride, mg/l	4	13	14	12
Sulfate, mg/l	4	94.8	125	62
Total Fluoride, mg/l	3	0.3	0.4	0.2
Dissolved Arsenic, mg/l	1	0.01	0.01	0.01
Dissolved Cadmium, mg/l	1	0.004	0.004	0.004
Dissolved Chromium, mg/l	1	0.006	0.006	0.006
Dissolved Copper, mg/l	1	0.004	0.004	0.004
Total Iron, mg/l	2	0.2	0.33	0.07
Total Manganese, mg/l	2	0.575	0.930	0.220
Dissolved Lead, mg/l	1	0.001	0.001	0.001
Dissolved Zinc, mg/l	1	0.062	0.062	0.062

TABLE 2.1.6.-21 ALLEGHENY RIVER WATER QUALITY, 1975-77

(From EPA's STORET System)

Parameter	WQN Station No. 801 Allegheny River at New Kensington				WQN Station No. 803 Allegheny River at PR 368				WQN Station No. 804 Allegheny River at Franklin			
	No. of Samples	Mean Value	Maximum Value	Minimum Value	No. of Samples	Mean Value	Maximum Value	Minimum Value	No. of Samples	Mean Value	Maximum Value	Minimum Value
Water Temperature, °C	9	8.9	24.0	0	23	8.7	21.5	0	25	11.6	25.0	0
Flow, cfs	4	30,125	58,600	18,500	23	14,756	56,000	3,000	26	11,712	48,200	2,880
Turbidity, JTU	2	5.3	5.6	5.0	13	6.2	18.0	1.6	34	8.0	40.0	2.0
Conductivity at 25°C, micromhos/cm	9	239	320	180	25	1,236	26,600	120	34	158	290	100
Dissolved Oxygen, mg/l -	8	11.8	14.0	8.0	23	11.0	13.6	8.0	27	10.7	15.0	7.7
pH, Standard Units	9	7.1	8.1	6.7	23	7.4	8.1	6.7	29	7.4	8.4	6.7
Total Alkalinity, mg/l as $CaCO_3$	9	21	34	16	25	46	256	14	34	40	147	20
Mineral Acidity, mg/l	8	0	0	0	25	0	0	0	--	--	--	--
Acidity from CO_2, mg/l	9	0	0	0	25	0	0	0	2	0	0	0
Total Residue, mg/l	--	--	--	--	--	--	--	--	13	112	152	68
Dissolved/105° Residue, mg/l	8	149	205	105	24	118	190	60	33	110	180	66
Total Nonfilterable Residue, mg/l	--	--	--	--	--	--	--	--	22	15	56	2
Settleable Residue, ml/l	--	--	--	--	--	--	--	--	15	0.283	0.800	0.004
Oil and Grease, mg/l	--	--	--	--	--	--	--	--	--	--	--	--
Total NH_3-N, mg/l	9	0.31	0.89	0.10	25	0.19	1.40	0.03	34	0.17	0.91	0
Total NO_2-N, mg/l	8	0.034	0.120	0.004	23	0.009	0.020	0.002	34	0.014	0.048	0
Total NO_3-N, mg/l	6	0.60	1.06	0.04	21	0.52	1.39	0.17	34	0.69	2.16	0
Total Phosphorus, mg/l P	9	0.14	0.20	0.02	24	0.13	0.53	0.02	34	0.07	0.20	0.01
Total Cyanide, mg/l	--	--	--	--	--	--	--	--	--	--	--	--
Total Hardness, mg/l as $CaCO_3$	9	89	122	60	25	69	140	22	34	60	120	36
Dissolved Calcium, mg/l	9	22.8	30.3	15.0	24	18.2	27.9	6.7	28	17.0	32.9	9.6
Dissolved Magnesium, mg/l	9	8.6	15.0	5.3	24	5.5	17.3	0	28	4.7	10.2	2.2
Chloride, mg/l	9	16.4	20.0	12.0	23	16.1	35.0	10.0	34	14.7	21.0	7.0
Total Sulfate, mg/l	9	67	95	35	25	35.9	400.0	10.0	34	16	32	4
Total Fluoride, mg/l	--	--	--	--	--	--	--	--	--	--	--	--
Total Arsenic, mg/l	1	0.020	0.020	0.020	2	0.060	0.100	0.020	--	--	--	--
Total Cadmium, mg/l	2	0.020	0.020	0.020	2	0.015	0.020	0.010	2	0.003	0.003	0.003
Total Chromium, mg/l	2	0.050	0.050	0.050	2	0.050	0.050	0.050	3	0.013	0.020	0.010
Total Copper, mg/l	2	0.050	0.050	0.050	2	0.050	0.050	0.050	3	0.013	0.020	0.010
Total Iron, mg/l	9	1.093	1.900	0.550	25	0.426	1.250	0.050	35	0.808	2,990	0.040
Total Lead, mg/l	2	0.100	0.100	0.100	2	0.055	0.100	0.010	3	0.037	0.050	0.010
Manganese, mg/l	2	0.655	0.810	0.500	25	0.158	0.660	0.020	2	0.085	0.100	0.070
Total Nickel, mg/l	2	0.050	0.050	0.050	2	0.050	0.050	0.050	2	0.018	0.020	0.015
Total Zinc, mg/l	2	0.075	0.100	0.050	2	0.050	0.070	0.030	3	0.033	0.070	0.010
Total Aluminum, mg/l	2	0.975	1.450	0.500	25	0.227	0.800	0.010	3	0.447	0.640	0.200
Total Coliforms, no./100 ml	--	--	--	--	--	--	--	--	--	--	--	--
Fecal Coliforms, no./100 ml	--	--	--	--	21	360	5,900	20	17	337	4,300	10
Total Phenols, mg/l	--	--	--	--	--	--	--	--	--	--	--	--
Total Mercury, mg/l	1	0.0005	0.0005	0.0005	2	0.0008	1.000	0.0005	2	0.002	0.002	0.002

TABLE 2.1.6-22 KISKIMINETAS, CONEMAUGH, AND CLARION RIVER WATER QUALITY, 1975-77 (FROM EPA's STORET SYSTEM)

Parameter	WQN Station No. 809 Kiskiminetas River at Vandergrift				WQN Station No. 810 Conemaugh River at Tunnelton				WQN Station No. 821 Clarion River at Piney			
	No. of Samples	Mean Value	Maximum Value	Minimum Value	No. of Samples	Mean Value	Maximum Value	Minimum Value	No. of Samples	Mean Value	Maximum Value	Minimum Value
Water Temperature, ^{o}C	15	8.2	22.0	0	8	10.5	31.0	0.3	9	9.1	21.0	0
Flow, cfs	5	2,204	2,980	1,200	5	2,348	4,320	1,070	10	4,043	4,800	2,460
Turbidity, JTU	9	17.1	36.0	3.2	4	16.3	28.0	4.0	10	3.0	5.0	1.0
Conductivity at 25^{o}C, micromhos/cm	16	493	1,000	275	9	471	720	200	10	171	240	110
Dissolved Oxygen, mg/l	14	10.5	14.0	4.0	7	12.2	19.0	9.0	10	10.1	14.0	7.0
pH, Standard Units	14	4.9	6.8	3.7	8	4.8	5.6	3.7	10	5.9	6.9	5.1
Total Alkalinity, mg/l as $CaCO_3$	16	1.25	10	0	9	4.1	25.0	0	10	6.3	18.0	2.0
Mineral Acidity, mg/l	13	5.8	30	0	8	6.3	50.0	0	-	-	-	-
Acidity from CO_2, mg/l	15	58	180	12	9	28.6	60.0	0	3	5	10	2
Total Residue, mg/l	-	-	-	-	-	-	-	-	4	113	144	56
Dissolved/105^{o} Residue, mg/l	15	282	667	144	8	297	500	140	10	128	176	54
Total Nonfilterable Residue, mg/l	-	-	-	-	-	-	-	-	7	3.7	6.0	2.0
Settleable Residue, ml/l	-	-	-	-	-	-	-	-	4	0.11	0.20	0.05
Oil and Grease, mg/l	-	-	-	-	-	-	-	-	-	-	-	-
Total NH_3-N, mg/l	16	0.80	1.85	0.20	9	0.76	1.64	0.20	10	0.18	0.41	0.06
Total NO_2-N, mg/l	15	0.012	0.038	0.002	8	0.019	0.038	0.002	10	0.016	0.026	0.007
Total NO_3-N, mg/l	13	0.89	1.50	0.04	6	1.06	1.64	0.64	10	0.61	1.40	0.23
Total Phosphorus, mg/l P	16	0.13	0.37	0.02	8	0.20	0.46	0.03	10	0.03	0.07	0.01
Total Cyanide, mg/l	9	0.03	0.05	0.01	-	-	-	-	-	-	-	-
Total Hardness, mg/l as $CaCO_3$	16	171	475	80	9	153	225	65	10	63	78	44
Dissolved Calcium, mg/l	16	40.0	83.9	21.0	9	39	65	18	9	15.4	32.1	9.8
Dissolved Magnesium, mg/l	16	17.2	64.6	7.1	9	14	21	4.6	9	5.7	8.8	2.0
Chloride, mg/l	16	15.3	21.0	11.0	9	14	28	7.0	10	9.1	14.0	6.0
Total Sulfate, mg/l	16	175	300	65	9	167	270	60	10	49	76	30
Total Fluoride, mg/l	16	0.18	0.28	0.10	8	0.16	0.22	0.10	-	-	-	-
Total Arsenic, mg/l	-	-	-	-	-	-	-	-	-	-	-	-
Total Cadmium, mg/l	-	-	-	-	1	0.003	0.003	0.003	1	0.001	0.001	0.001
Total Chromium, mg/l	-	-	-	-	1	0.040	0.040	0.040	1	0.010	1.010	0.010
Total Copper, mg/l	-	-	-	-	1	0.040	0.040	0.040	1	0.020	0.020	0.020
Total Iron, mg/l	15	6.026	16.000	0.400	9	3.475	8.000	0.450	10	0.645	1.210	0.180
Total Lead, mg/l	-	-	-	-	1	0.050	0.050	0.050	1	0.010	0.010	0.010
Manganese, mg/l	15	1.212	2.800	0.620	9	1.141	1.770	0.600	1	0.960	0.960	0.960
Total Nickel, mg/l	-	-	-	-	1	0.100	0.100	0.100	1	0.050	0.050	0.050
Total Zinc, mg/l	-	-	-	-	1	0.140	0.140	0.140	1	0.120	0.120	0.120
Total Aluminum, mg/l	15	2.917	10.000	0.800	9	2.539	4.700	0.100	5	0.610	1.200	0.250
Total Coliforms, no./100 ml	-	-	-	-	-	-	-	-	-	-	-	-
Fecal Coliforms, no./100 ml	15	24	60	20	-	-	-	-	5	10	10	10
Total Phenols, mg/l	10	0.011	0.041	0.003	-	-	-	-	-	-	-	-
Total Mercury, mg/l	-	-	-	-	-	-	-	-	-	-	-	-

FIGURE 2.1.6.-26 SPATIAL WATER QUALITY PROFILE -- LITTLE CONEMAUGH/CONEMAUGH RIVER, OCTOBER 1974 Source (3)

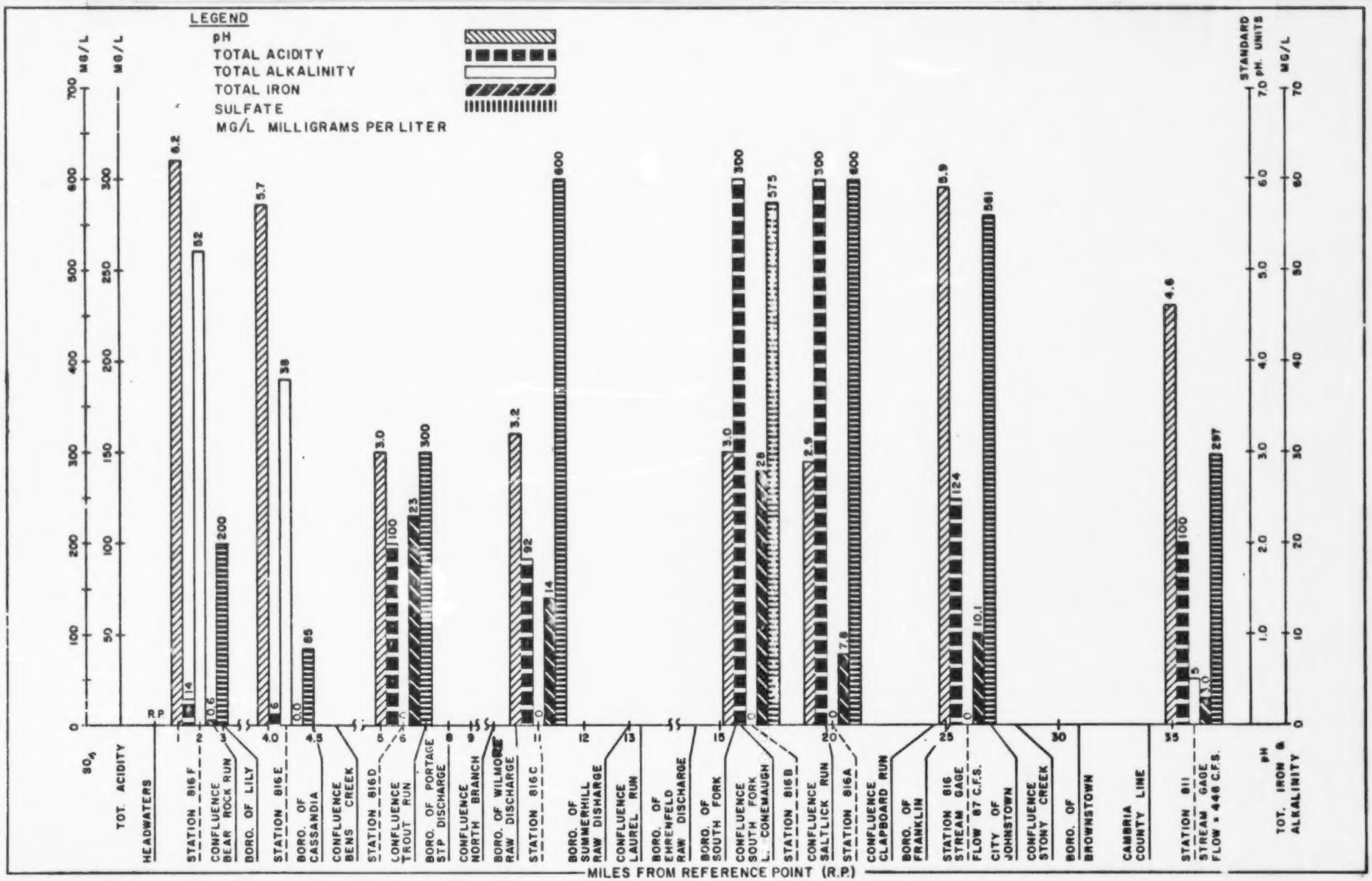


FIGURE 2.1.6.-27 SPATIAL WATER QUALITY PROFILE -- STONY CREEK, MARCH 1973

Source (3)

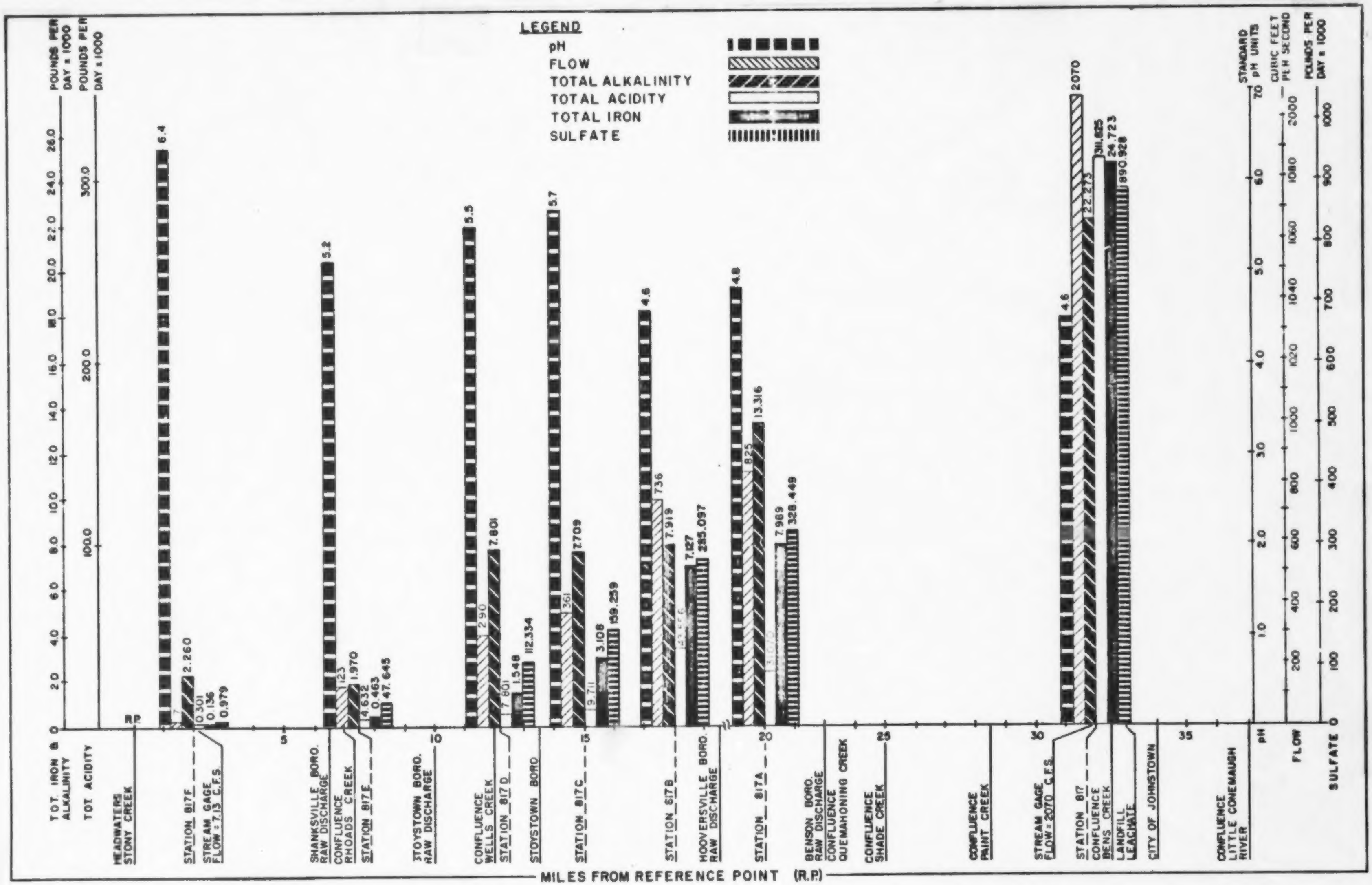


FIGURE 2.1.6.-28 TEMPORAL WATER QUALITY PROFILE -- CONEMAUGH RIVER, STATION 811, 1970-1974 Source (3)

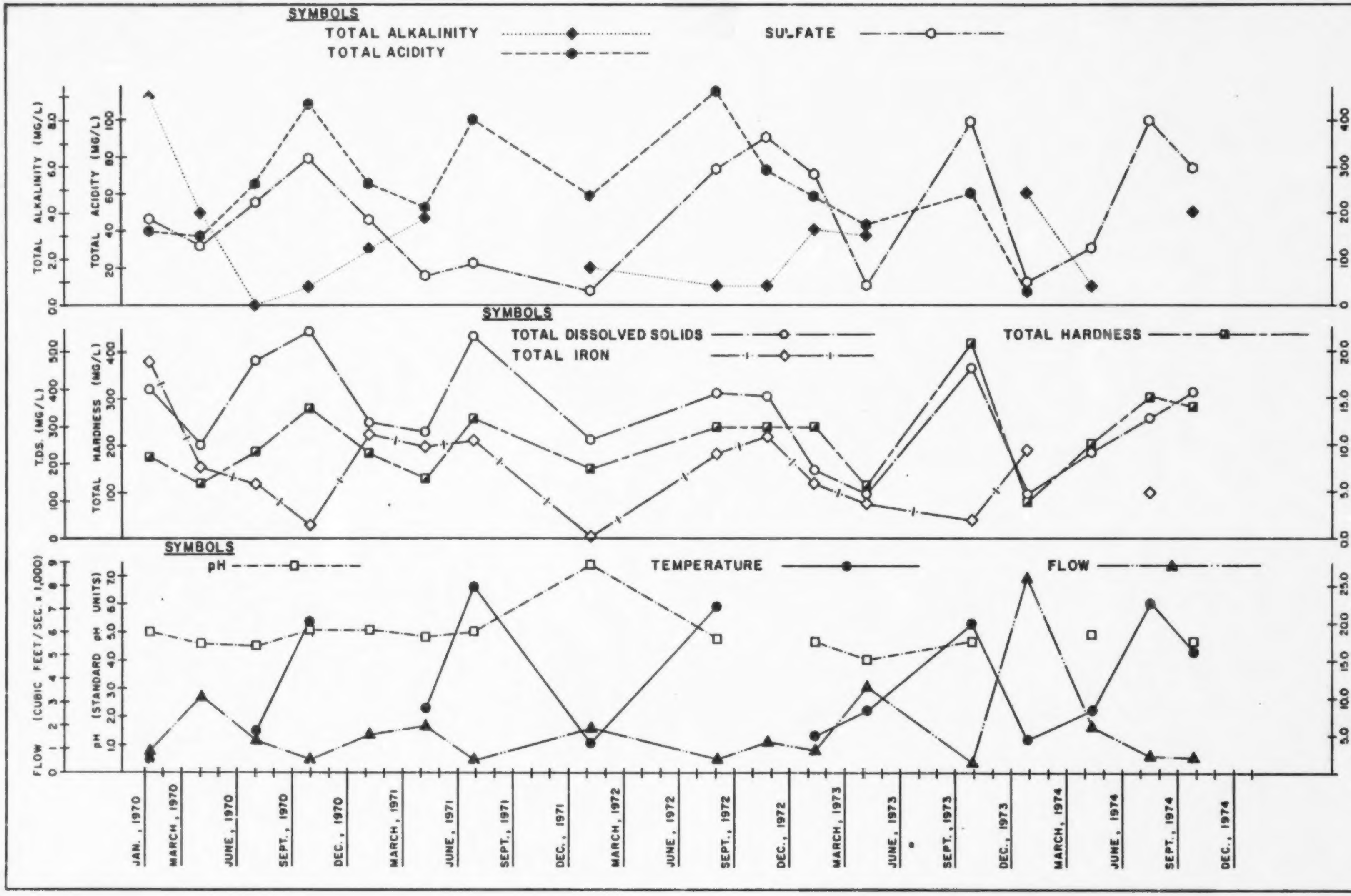


TABLE 2.1.6.-23 CLASSIFICATION AND QUALITY PROBLEMS OF MAJOR STREAMS - ALLEGHENY RIVER BASIN

SOURCES (2), (25), (26)

Stream	Stream Segment	CO-WAMP Sub-Basin	Class (a)	Category (b)	Problems	Causes of Problems (Parameter Group Violation) (c)	Miles of Stream Degraded By Problems
Sugar Creek		16D				Sewage, filter backwash.	
Oil Creek	Lower Reach	16E			Oil pollution.	Oil drilling and related operations.	3.5
Johnson Run	Entire Watershed	17A	AMD	II			
Daguscahonda Run	Entire Watershed	17A	AMD	II			
Elk Creek	Vicinity of St. Marys.	17A	AMD	II	Solids and iron precipitates are primary problems.	Water quality affected by heavy industrial loads, landfill discharge and acid mine drainage.	8
Brandy Camp Creek	Brandy Camp to Mouth	17A	AMD	II			
Meade Run	Shawmut to Mouth	17A	AMD	II			
Toby Creek	Main Stem Only (Elk & Jefferson Co)	17A	AMD	II			
W.Br. Clarion R.	Halsey to Wilcox	17A			Brines.	Abandoned gas wells.	
Mill Creek	Main Stem Only	17B	AMD	III		Water quality affected by acid mine drainage (1, 4, 5).	52.5
Toby Creek	Entire Watershed (Clarion County)	17A, B	AMD	III			
Piney Creek	Entire Watershed	17B	AMD	III			
Deer Creek	Entire Watershed	17B	AMD	III			
Licking Creek	Entire Watershed	17B	AMD	III			
Canoe Creek	Entire Watershed	17B	AMD	III			
Clarion River	Mill Creek to Mouth	17B	AMD	III	Depressed dissolved oxygen levels, color.	Discharges of raw sewage and inadequately treated paper mill wastes (2, 3, 4).	4
Sandy Lake		16G	WQL	II	Phosphorus.		
Sandy Creek	Above Lake Wilhelm Dam	16G	WQL	II	Phosphorus, turbidity.	Water treatment filter backwash.	
East Sandy Creek	Headwater Area	16G	AMD			Acid mine drainage (1, 4, 5).	9
Scrubgrass Creek	Entire Watershed	16G	AMD		Acid mine drainage.	Abandoned mines (1, 4, 5).	6
Sandy Lick Creek		17C			Dissolved oxygen, acid mine drainage.	Raw sewage discharges at Falls Creek Borough & Reynoldsville, abandoned mines (1, 2, 3, 4, 5).	3
Bear Creek	South Branch & Main Stem below Confluence to source. North Branch	17C	WQL	III	MBAS; Oil; BOD; NH_3; toxic organics; Iron, Sulfates, low pH.	Petrochemical wastes from Petrolia area; raw & inadequately treated sewage discharge from Bruin-Petrolia-Karns City area; minor affect from acid mine drainage. North branch affected by drainage from extensive strip mining and oil and gas wells. (1,2,3,4,5)	20

TABLE 2.1.6.-23 (Continued)

Stream	Stream Segment	CO-WAMP Sub-Basin	Class (a)	Category (b)	Problems	Causes of Problems (Parameter Group Violation) (c)	Miles of Stream Degraded By Problems
Redbank Creek		17C				Water quality degradation due to discharges of inadequately treated & raw sewage (2, 4).	3
Soldier Run	Entire Watershed	17C	AMD	III			
Goder Run	Main Stem Only	17C	AMD	III			
Beaver Run	Main Stem Only	17C	AMD	III			
Pine Creek	Entire Watershed	17C	AMD	III			
Middle Run	Entire Watershed	17C	AMD	III			
Long Run	Entire Watershed	17C	AMD	III			
Leatherwood Creek	Jack Run to Mouth	17C	AMD	III			
Rock Run	Entire Watershed	17C	AMD	III			
Wildcat Run	Entire Watershed	17C	AMD	III			
Welch Run	Entire Watershed	17C	AMD	III		Acid mine drainage pollution (1, 4, 5).	36
Runaway Run	Entire Watershed	17C	AMD	III			
Town Run		17C	AMD	III			
Leisure Run	Entire Watershed	17C	AMD	III			
Fiddlers Run		17C	AMD	III			
Catfish Run		17C	AMD	III			
Redbank Creek	Mouth to ?	17C	AMD	III			
Stump Creek	Main Stem Only	17D	AMD	III			
Little Elk Run	Entire Watershed	17D	AMD	III			
Hamilton Run	Entire Watershed	17D	AMD	III			
Glade Run	Entire Watershed	17D	AMD	III		Acid mine drainage.	
Pine Run	Entire Watershed	17D	AMD	III		Acid mine drainage.	
Mahoning Creek	Pine Run to Mouth	17D	AMD	III		Affected by coal washing water from Carpentertown Coal & Coke Works; severe acid mine drainage at mouth (1, 4, 5).	22
Cowanshannock Creek		17E			Iron	Acid mine drainage & inadequately treated sewage in headwater areas; leaching coal refuse piles along the stream (1,2,3,4,5)	18

TABLE 2.1.6.-23 (Continued)

Stream	Stream Segment	CO-WAMP Sub-Basin	Class (a)	Category (b)	Problems	Causes of Problems (Parameter Group Violation) (c)	Miles of Stream Degraded By Problems
Plum Creek, North Branch	Entire Watershed, except below Keystone Lake	17E	WQL	III	Phosphorus;low pH.		
Crooked Creek	Main Stem; McKee Run to Mouth	17E	AMD	III		Aquatic biology studies indicate severe mine drainage pollution at mouth. Abandoned, unsealed mines located in this basin (1, 4, 5).	6
Buffalo Creek	Headwaters	18F			Low pH; Iron.	Acid mine drainage from strip mining in headwater areas (1, 4, 5).	5
Stony Creek	Entire Watershed (Esp. Bens, Paint, Shade, and Quemahoning Creeks)	18E				Raw sewage discharge & acid mine drainage affect Stony Creek & its tributaries, also landfill leachate (1, 2, 3, 4, 5).	20
Little Conemaugh River		18E			pH, Iron, Sulfate.	Raw sewage discharge & acid mine drainage adversely affect water quality conditions throughout most of the stream (1, 2, 3, 4, 5).	25
Johnston Run		18E				Inadequately treated municipal & industrial wastes are adversely affecting water quality (1, 2).	3
South Fork & North Branch Little Conemaugh River		18E				Raw sewage discharges & acid mine drainage problems (1, 2, 3, 4, 5).	18
Aulds Run	Entire Watershed	18D	AMD	III			
Aultmans Run	Entire Watershed	18D	AMD	III		Acid mine drainage.	
Blacklick Creek North Branch	Entire Watershed	18D	WQL	III	Iron, Suspended Solids, pH, Sulfate.	Discharge from active mines.	
Blacklick Creek	Source to Mouth	18D	AMD	III		Sewage problems due to raw discharge & malfunctioning on-lpt systems; acid drainage from strip mining (1,2,3,4,5).	27
Buck Run	Entire Watershed	18D	AMD	III			
Dixon Run	Entire Watershed	18D	AMD	III		Acid mine drainage.	
Laurel Run	Entire Watershed	18D	AMD	III			
Maridis Run	Main Stem	18D	AMD	III			
Penn Run	Entire Watershed	18D	AMD	III		Acid mine drainage.	
Ramsey Run	Entire Watershed	18D	AMD	III			

TABLE 2.1.6.-23 (Continued)

Stream	Stream Segment	CO-WAMP Sub-Basin	Class (a)	Category (b)	Problems	Causes of Problems (Parameter Group Violation) (c)	Miles of Stream Degraded By Problems
Richards Run	Entire Watershed	18D	AMD	III		Acid mine drainage.	
Rummel Run	Entire Watershed	18D	AMD	III			
Tearing Run	Entire Watershed	18D	AMD	III			
Tubmill Creek	Hendricks Creek to Mouth	18D	AMD	III			
Twolick Creek, North Branch	Entire Watershed	18D	AMD	III			
Twolick Creek	Source to Mouth	18D	AMD	III		Raw sewage discharged to Creek in Homer City & Clymer areas; acid mine drainage from deep mines & strip mining in lower reaches (1, 2, 3, 4, 5).	13
Yellow Creek	Entire Watershed above Moosehill	18D	WQL	III			
Yellow Creek	Watershed Below Homer City Water Dam	18D	AMD	III		Affected by acid mine discharges from abandoned mines & runoff from refuse piles below the Homer City water reservoir (1, 4, 5).	3
Conemaugh River	Entire Stream	18C, D	AMD	III		One of the most severely polluted streams in Pennsylvania. Seriously affected by acid mine drainage in headwaters & from leachate from coal refuse piles in Seward & New Florence areas. Inadequately treated industrial wastes & sewage, particularly in the Johnstown area, add to the overall pollutional load (1, 2, 3, 4, 5).	25
Big Run	Entire Watershed	18C	AMD	III			
Blacklegs Creek	Main Stem; Source to Mouth	18C	AMD	III		Acid mine drainage.	
Crabtree Creek	Entire Watershed	18C	AMD	III		Acid mine drainage.	
Getty Run	Entire Watershed	18C	AMD	III		Acid mine drainage.	
Keystone Lake	Watershed area above Keystone Lake Dam	18C	WQL	III	Phosphorus.		
Loyalhanna Creek	Ninemile Run to Mouth	18C	AMD	III	pH, Iron.	Affected by acid mine drainage below Latrobe & malfunctioning septic tanks in New Alexandria area (1, 2, 3, 4, 5).	23
Monastery Run	Entire Watershed	18C	AMD	III			
Ninemile Run	From Bagally to Mouth	18C	AMD	III			

TABLE 2.1.6.-23 (Continued)

Stream	Stream Segment	CO-WAMP Sub-Basin	Class (a)	Category (b)	Problems	Causes of Problems (Parameter Group Violation) (c)	Miles of Stream Degraded By Problems
Saxman Run	Entire Watershed	18C	AMD	III		Acid mine drainage.	
Sulfur Run	Entire Watershed	18C	AMD	III		Acid mine drainage.	
Union Run	Entire Watershed	18C	AMD	III		Acid mine drainage.	
Whiskey Run	Entire Watershed	18C	AMD	III		Acid mine drainage.	
Beaver Run	Watershed above Beaver Run Dam	18B	WQL	III	Phosphorus; NH_3	Sewage.	
Beaver Run	Dam to Mouth	18B	AMD	III		Acid mine drainage seriously affects water quality downstream from the Beaver Run reservoir, affected by sewage above reservoir (1, 2, 3, 4, 5).	5
Big Spring Run		18B	AMD	III	pH and Iron.	Strip mines (1, 4, 5).	
Guffy Run	Entire Watershed	18B	AMD	III		Acid mine drainage.	
Kiskiminetas River	Source to Mouth	18B	AMD	III	pH and Iron.	Water quality adversely affected by acid mine drainage & raw sewage discharges the entire length of the stream (1, 2, 3, 4, 5).	27
Long Run	Entire Watershed	18B	AMD	III		Acid mine drainage.	
Wolford Run	Entire Watershed	18B	AMD	III		Acid mine drainage.	
Allegheny River	Kiskiminetas River to Mouth	18A	WQL	I	Fecal Coliform; Combined Sewers; Settleable Solids; Oil; Iron.	Water quality affected by flow from Kiskiminetas River, urban runoff and industrial wastes (1, 2, 3, 4, 5).	10
Allegheny River, Tributaries of	Kiskiminetas River to Mouth, except Pine Creek and Deer Creek	18A	WQL	III	BOD: NH_3; Oil, Suspended Solids.		
Pine Creek	Watershed above North Park Lake	18A	WQL	III	BOD: NH_3; Oil; Suspended Solids; Phosphorus.	Inadequately treated sewage & industrial wastes. Biological studies indicate good water quality upstream from Wildwood Mine, with downstream reaches biologically depressed from mine drainage (1, 2, 3, 4, 5).	6
Pine Creek	Entire Watershed, except above North Park Lake	18A	WQL	III	BOD: NH_3; Oil; Suspended Solids; Heavy Metals; Phenols.		
Deer Creek		18A			High Sulfate and Zinc levels in West Deer Township. Acid mine drainage.	Aquatic biological studies indicate upstream reaches depressed by siltation & sewage & mine drainage from Indianaola shafts (1, 2, 3, 4, 5). Landfill areas.	9

TABLE 2.1.6.-23 (Continued)

Stream	Stream Segment	CO-WAMP Sub-Basin	Class (a)	Category (b)	Problems	Causes of Problems (Parameter Group Violation) (c)	Miles of Stream Degraded By Problems
Little Deer Creek		18A			Acid mine drainage.	Water quality adversely affected, particularly from the Russelton Mine (1, 4, 5).	9
Plum Creek		18A				Water quality adversely affected by acid mine drainage & sewerage overflows (1, 2, 3, 4, 5).	7
Little Plum Creek		18A				Coal refuse disposal area.	
Willow Run		18A				Industrial discharges.	

NOTES:

(a) CLASSES:

WQL = Water Quality Limited Stream
EL = Effluent Limited Stream
AMD = Acid Mine Drainage Affected Stream

(b) CATEGORIES:

See definition in Section 2.1.6.4.

(c) PARAMETER GROUPS:

1 = Harmful substances (heavy metals, chemicals, pesticides, other toxins)
2 = Oxygen depletion
3 = Eutrophication potential (phosphorus, nitrogen)
4 = Physical modification (temperature, turbidity, suspended solids, color, flow)
5 = Salinity, acidity, alkalinity (conductivity, pH, alkalinity, total dissolved solids)

Cowanshannock Creek at Rural Valley, the lower portion of Clarion River, and Johnston Run are beset by periodic oxygen depletion and high mutrient, BOD, and suspended solids concentrations due to these wastes.

Several streams suffer from both municipal/industrial waste discharges, as well as acid mine drainage: Elk Creek in the vicinity of St. Marys, Little Toby Creek, Sandy Lick Creek, Bear Creek, Plum Creek, Pine Creek, Loyalhanna Creek, the Kiskiminetas River in the Vandergrift area, Twolick Creek, Yellow Creek, Blacklick Creek, the Little Conemaugh/Conemaugh Rivers, and Stony Creek.

An additional problem in the Upper Basin is water quality degradation caused by oil and gas well brine. The last few miles of Oil Creek, the uppermost reach of the West Branch Clarion River, and the north branch of Bear Creek are most severely affected by this problem.

High solids and turbidity, caused by water treatment plant filter backwash are the major problems in Sugar and Sandy Creeks.

The water quality of the Allegheny River itself is generally good due to the high base flow provided by Allegheny Reservoir. Because of the augmented flow the river can absorb most waste loads in the basin but localized areas of degradation caused by inadequately treated municipal and industrial discharges exist. The Tionesta area and the Ford City-Kittanning area near Emlenton are most severely affected.

4. Compliance Status

The means and maxima of the various water quality parameters at the WQN Stations are compared with the 1974 State criteria in Table 2.1.6.-24 as compiled from References (1), (2), (25), and (26). The actual concentrations listed did not meet the criteria. Criteria for pH, metals, coliforms, and phenols were most often exceeded while those for dissolved oxygen, TDS and

TABLE 2.1.6.-24 COMPLIANCE STATUS 1975 - ALLEGHENY RIVER BASIN

SOURCES (1), (2), (25), (26)

GENERAL INFORMATION								SPECIFIC WATER QUALITY PARAMETERS							POTENTIAL PROBLEMS						
Station No.	Stream	Class (a)	Category (b)	CO-WAMP Sub-basin	County	Criter Stand. Group (c)	Average Flow cfs	pH S.U.	D.O. mg/l	TOT.Fe mg/l	TEMP. oC	TDS mg/l	ODOR S.U.	Total Colif. /100ml	ALL VALUES GIVEN AS mg/l					Overall Quality Rating	Will Stream Meet Water Quality Standards By 1933?
								mean/max.													
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)	(19)	(20)	(21)	(22)
801	Allegheny River	EL	I	18A	Westmoreland	B+h,k	20775	OK/ 4.7	OK	5/ 13.4	OK	OK	34/55	12300/ 123500	Phenol .026/ .110	Al 3.4/21	Zn .062/ .062	SO_4 OK/300	Mn 1.5/26	Fair	No. Inadequate funds to correct acid & iron problems in the Kiskiminetas River.
802	Allegheny River	AMD	III	17E	Armstrong	B	14113	OK/OK	OK	OK/3	OK	OK		7800/ 169700	Phenols OK/.036	Al 4.1/14	Tot.Alk 9229/ 800000			Fair to good	
803	Allegheny River	AMD	III	17C	Armstrong	B+h, j_1, o_1	12927	OK/OK	OK	OK/ 10.0	OK	OK	30/37	32600/ 818200	Phenols .022/ .05					Good	
804	Allegheny River	EL	II	16G	Venango	B+h, j_1,o_1	9019	OK/OK-8.8	OK	OK/14	OK	OK	38/45	59400/ 537400	SO_4 OK/ 296.0					Good	
805	Allegheny River	EL	II	16F	Forest	B+h, j_1, o_1	6347	OK/OK	OK/0	OK/ 3.6	OK	OK	34/47	11600/ 165600	Ni.111/ .111					Good	
808	Buffalo Creek	WQL	I	18F	Armstrong	B-b_2 +b_6	193	OK/ 4.5	OK/0	OK/ 9.6	OK	OK		49300/ 350000	Al 3.6/ 12					Fair	No. Lack of funds.
809	Kiskiminetas River	AMD	III	18B	Westmoreland	B+v_2	3330	4.3/3	OK/.8	8.8/ 32	OK	OK/ 760	NH_3-N OK/ 1.8	250/ 3500	Phenol OK/.040	Al 10.7/ 53	Zn .647/ .870	Ni .170/ .230	Mn 3.9/20	Poor	No. Lack of funds for mine drainage projects.
810	Conemaugh River	AMD	III	18C	Indiana	B+v_2	2477	4.2/3	OK/.8	7.9/ 28	OK	OK	NH_3-N OK/ 2.6	60/ 1400	Phenol OK/.030	Al 9.9/43	Zn 1.030/ 1.030	Ni .150/ .150	SO_4 299/950	Poor	No. Lack of funds for mine drainage projects, and lack of federal grants for sewage facilities.
811	Conemaugh River	AMD	III	18D	Westmoreland	B+v_2	1318	4.9/ 3.9	OK	13.1/ 58	OK	OK	NH_3-N OK/ 4.4	2500/ 24000	Phenols .039/ .090	Al 8.5/25	Zn 1.063/ 1.960	Ni .166/ .180	CN 1.069/ 1.069		
812	Loyalhana Creek	AMD	III	18C	Westmoreland	B+v_2	381	4.8/3	OK	7.9/ 80	OK	OK		1400/ 27000	Al 10/57	Zn .050/ .050	SO_4 341/ 1350			Severely depressed	Yes.

NOTES: (a) Classes: WQL = Water Quality Limited Stream
EL = Effluent Limited Stream
AMD = Acid Mine Drainage Affected Stream

(b) Categories: See definition in text, Section 2.1.6.4.
(c) 1974 Pa. Water Quality Criteria Groups and Levels as defined in Reference (28).
(d) Data Source: USGS Water Resources Bulletin No. 1.
(e) Discontinued.

TABLE 2.1.6.-24 (Continued)

GENERAL INFORMATION								SPECIFIC WATER QUALITY PARAMETERS							POTENTIAL PROBLEMS						
Station No.	Stream	Class (a)	Category (b)	CO-WAMP Sub-basin	County	Criter Stand. Group (c)	Average Flow cfs	pH S.U.	D.O. mg/1	TOT.Fe mg/1	TEMP. °C	TDS mg/1	ODOR S.U.	Total Colif. /100ml	ALL VALUES GIVEN AS mg/1					Overall Quality Rating	Will Stream Meet Water Quality Standards By 1983?
								mean/max.													
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)	(19)	(20)	(21)	(22)
813	Loyalhana Creek	AMD	III	18C	Westmoreland	$B+v_2$	329	OK/4.6	OK	OK/9.0	OK	OK		16500/240000	Phenols .020/.050	Al 3.2/57	Zn OK/.060	Mn OK/10		Good to excellent	Yes.
814	Black Lick Creek	AMD	III	18D	Indiana	$C+v_1$	422	3.6/2.8	OK/3.0	62.9/300	OK/27	OK	NH_3-N OK/.8	OK/OK	Al 25/136	Zn .280/.280	Ni .120/.120	SO_4 574/2325	Mn 2.3/7.0	Poor	No. Lack of funds for mine drainage abatement projects and lack of federal grants for sewage facilities.
815	Two Lick Creek	AMD	III	18D	Indiana	$C+v_1$	254	4.2/3	OK/2.7	20/75	OK	OK		1100/21100	Al 9.1/56.	Zn .095/.140	SO_4 331/1040	Mn 2.0/5.5	NH_3-N .54/1.4	Poor	Yes- Above Homer City area; No- below Homer City due to lack of funds for mine drainage control.
818	Crooked Creek	AMD	III	17E	Armstrong	$B+v_2$	503	5.8/3.4	OK	1.9/1.4	OK	OK		1200/16500	Phenols OK/.040	Al 2.7/14	Zn .050/.080	SO_4 OK/520		Poor at mouth	No. Inadequate funds to complete acid mine drainage control.
819	Mahoning Creek	AMD	III	17D	Armstrong	$B+v_2$	654	OK/5.8	OK	OK/2.	OK	OK		52200/800100	Phenols .035/.150	Al 3.6/14	Zn .137/.330				Yes.
820	Redbank Creek	AMD	III	17C	Clarion	$C+v_1$	758	OK/4.5	OK/1.0	OK/14.0	OK/28	OK		12700/186100	SO_4 OK/225	Al OK/2.8	Phenol OK/.023			Poor near mouth	No. Low priority for upgrading treatment facilities at Summerville.
821	Clarion River	AMD	III	17E	Clarion	A+h	1739	5.6/4.5	OK/4.1	OK/3.4	OK/25	OK	32/54	300/3900	Mn 3.7/3.7	Zn 1.6/1.6	Al OK/2.6	Phenol OK/.040		Poor	No. Lack of funds for mine drainage control projects.
822	Clarion River	AMD	III	17B	Clarion	A+h	1427 (d)													Poor	

NOTES: (a) Classes: WQL = Water Quality Limited Stream
EL = Effluent Limited Stream
AMD = Acid Mine Drainage Affected Stream

(b) Categories: See definition in text, Section 2.1.6.4.
(c) 1974 Pa. Water Quality Criteria Groups and Levels as defined in Reference (28).
(d) Data Source: USGS Water Resources Bulletin No. 1.
(e) Discontinued.

TABLE 2.1.6.-24 (Continued)

GENERAL INFORMATION								SPECIFIC WATER QUALITY PARAMETERS							POTENTIAL PROBLEMS						
Station No.	Stream	Class (a)	Category (b)	CO-WAMP Sub-basin	County	Criter Stand. Group (c)	Average Flow cfs	pH S.U.	D.O. mg/1	TOT.Fe mg/1	TEMP. oC	TDS mg/1	ODOR S.U.	Total Colif. /100ml	ALL VALUES GIVEN AS mg/1					Overall Quality Rating	Will Stream Meet Water Quality Standards By 1983?
								mean/max.													
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)	(19)	(20)	(21)	(22)
823	Clarion River	AMD	III	17A	Elk	A+h	330	OK/ 5.3	OK/ 4.4	OK/ 1.8	OK/46* *Questionable	OK	37/64	133600/ 460000	Cu .408/ .796	Ni 1.65/ 1.65	Zn .231/ .392			Good	Yes.
824	West Branch Clarion River	AMD	III	17A	Elk	A+h	101	OK/ 5.9	OK	OK/ 2.2	OK/ 26	OK	28/54	61500/ 430000	Cl OK/540						
825	East Branch Clarion River	AMD	III	17A	Elk	A $-b_1+$ b_3, h	111	5.6/ 4.2	OK	OK/ 2.0	OK/ 22.5	OK	OK/44	OK/OK	Zn .084/ .160						
826	French Creek	WQL	II	16D	Venango	B+h, j_1, v_2	1222	OK	OK	OK/ 10.0	OK	OK	29/43	28000/ 137500	Ni .128/ .128	Phenol .033/ .080					
828 (e)	Oil Creek	EL	II	16E	Venango	A+h	344	OK/ 9.0	OK	OK/ 3.0	OK/ 27	OK	37/57	24200/ 550000	Phenol OK/.03					Good	No. Regulations governing crude oil recovery probably will not be implemented by then.
829	Tionesta Creek	EL	II	16F	Forest	A	801	OK/OK	OK/ 4.0	OK/ 2.0	OK/27	OK		1200/ 12000							
830	Tionesta Creek	EL	II	16F	Forest	A	392	OK/ 2.5	OK/0	OK/ 2.4	OK/29	OK		34800/ 845000							
833	Clarion River	AMD	III	17A	Elk	A+h	519	OK	OK	OK	OK/25	OK	35/47	29800/ 160900	Phenol 24/30					Good	
835 (e)	Mahoning Creek	AMD	III	17D	Jefferson	B+v_2	264 (d)													Fair	Yes.

NOTES: (a) Classes: WQL = Water Quality Limited Stream
EL = Effluent Limited Stream
AMD = Acid Mine Drainage Affected Stream

(b) Categories: See definition in text, Section 2.1.6.4.
(c) 1974 Pa. Water Quality Criteria Groups and Levels as defined in Reference (28).
(d) Data Source: USGS Water Resources Bulletin No. 1.
(e) Discontinued.

TABLE 2.1.6.-24 (Continued)

GENERAL INFORMATION								SPECIFIC WATER QUALITY PARAMETERS							POTENTIAL PROBLEMS						
Station No.	Stream	Class (a)	Category (b)	CO-WAMP Sub-basin	County	Criter Stand. Group (c)	Average Flow cfs	pH S.U.	D.O. mg/1	TOT.Fe mg/1	TEMP. oC	TDS mg/1	ODOR S.U.	Total Colif. /100ml	ALL VALUES GIVEN AS mg/1					Overall Quality Rating	Will Stream Meet Water Quality Standards By 1983?
								mean/max.													
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)	(19)	(20)	(21)	(22)
838	Pine Creek	WQL	I	18A	Allegheny	B-b_2, +b_5, e_2	1033 (d)	OK	OK	2.4/ 10.9	OK	OK			Zn .100/ .100	Ni .150/ .150	SO_4 254/ 725	CN .140/ .548	NH_3-N OK/.6	Good upstream from Wildwood Mine; depressed downstream	Yes.
839	Deer Creek	WQL	I	18A	Allegheny	A	42 (d)	OK	OK	OK	OK/ 20	OK			Zn .055/ .090	SO_4 OK/490	Tot.Alk. 147/270			Depressed upstream, some recovery downstream	Yes.
840 (e)	Buffalo Creek	WQL	I	18F	Butler	B-b_2 +b_6		OK/ 5.8	OK	OK	OK	OK								Poor	No. Lack of funds.
841	Cowanshannock Creek	AMD	III	17E	Armstrong	B+v_2		OK	OK	OK/ 1.8	OK	OK								Poor	No. Lack of funds for mine drainage abatement & treatment.
842 (e)	Mahoning Creek	AMD	III	17D	Armstrong	B+v_2	582 (d)	OK	OK	OK	OK	OK								Poor	Yes.
843	Clarion River	AMD	III	17B	Clarion	A+h	2252 (d)	5.6/ 5.7	OK	OK/ 2.8	25/ 27	OK			SO_4 OK/425	Mn 2.6/ 2.6	Zn .1/ .1			Poor	
844	Elk Creek	AMD	III	17A	Elk	A+h	291 (d)	OK	OK	OK	OK/ 22	OK								Fair	No. Lack of funds for mine drainage control projects.
845	French Creek	WQL	II	16D	Venango	B+h, j_1,v_2	265 (d)	OK/ OK-8.7	OK	OK/ 2.5	OK	OK									

NOTES: (a) Classes: WQL = Water Quality Limited Stream
EL = Effluent Limited Stream
AMD = Acid Mine Drainage Affected Stream

(b) Categories: See definition in text, Section 2.1.6.4.
(c) 1974 Pa. Water Quality Criteria Groups and Levels as defined in Reference (28).
(d) Data Source: USGS Water Resources Bulletin No. 1.
(e) Discontinued.

TABLE 2.1.3.-24 (Continued)

GENERAL INFORMATION								SPECIFIC WATER QUALITY PARAMETERS							POTENTIAL PROBLEMS						
Station No.	Stream	Class (a)	Category (b)	CO-WAMP Subbasin	County	Criter Stand. Group (c)	Average Flow cfs	pH S.U.	D.O. mg/1	TOT.Fe mg/1	TEMP. oC	TDS mg/1	ODOR S.U.	Total Colif. /100ml	ALL VALUES GIVEN AS mg/1					Overall Quality Rating	Will Stream Meet Water Quality Standards By 1983?
								mean/max.													
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)	(19)	(20)	(21)	(22)
848 (e)	Lake Creek	WQL	II	16D	Venango	$B+v_2$		OK	OK	OK	OK	OK									
852	Oil Creek	EL	II	16E	Venango	A+h	517 (d)	OK	OK	OK/ 1.7	22/26	OK			Pb .5/.5					Good	No. Regulations governing crude oil recovery probably will not be implemented by then.
853 (e)	Tionesta Creek	EL	II	16F	Forest	A	873 (d)	OK	OK	OK	23/24	OK									

NOTES: (a) Classes: WQL = Water Quality Limited Stream
EL = Effluent Limited Stream
AMD = Acid Mine Drainage Affected Stream

(b) Categories: See definition in text, Section 2.1.6.4.
(c) 1974 Pa. Water Quality Criteria Groups and Levels as defined in Reference (28).
(d) Data Source: USGS Water Resources Bulletin No. 1.
(e) Discontinued.

odor were mostly satisfied. Overall, the water quality standards were met on less than half of the total stream mileage in the basin and several of the streams were in poor condition -- mostly due to the abandoned mine drainage problem.

Between July 1, 1975 and June 30, 1976 the water quality of the Allegheny River at Oakmont exceeded ORSANCO's criteria (or ORBC's if no ORSANCO criteria were available) for the parameters tabulated below (37).

Parameter	pH	Total Suspended Solids	Fecal Coliforms for Recreation	Total Phosphorus	Phenol	Iron
% of Samples (or time) exceeding ORSANCO/ORBC Criteria	1	3	100	10	3	57

DER estimates that, as the result of continued cleanup efforts, Loyalhanna Creek, Two Lick Creek above Homer City, Mahoning Creek, Clarion River, Pine Creek, and Deer Creek will meet the standards by 1983 (29).

Lack of sufficient funds for mine drainage control projects will prevent attainment of the standards on several streams and the following waters were judged so polluted by acid mine drainage that implementation of some effluent limitations to meet water quality standards has been postponed (35):

Stream Name	County
Kiskiminetas River	Armstrong, Indiana, Westmoreland
Guffy Run	Armstrong
Beaver Run, dam to mouth	Westmoreland
Wolford Run	Westmoreland
Long Run	Armstrong
Sulfur Run	Indiana
Blacklegs Creek, main stem from source to mouth	Indiana
Big Run	Armstrong, Indiana
Whiskey Run	Indiana
Getty Run	Westmoreland
Union Run	Westmoreland
Conemaugh River	Indiana, Westmoreland
Aultmans Run	Indiana
Blacklick Creek	Indiana
Two Lick Creek, from Yellow Creek to mouth	Indiana
Tearing Run	Indiana

Yellow Creek, Homer City water dam to mouth	Indiana
Laurel Run	Indiana
Aulds Run	Indiana
Ramsey Run	Indiana
Mardis Run	Indiana
Rummel Run	Indiana
Pine Run	Armstrong
Crooked Creek below dam	Armstrong
Glade Run	Armstrong
Redbank Creek from St. Charles to mouth	Armstrong

5. Stream Quality Changes, 1973-77

Tables 2.1.6.-25 and 2.1.6.-26 summarize the stream lengths showing improvement or degradation, respectively, in water quality during the last five years in the Allegheny River Basin along with the reason for the improvement or degradation (25).

ORSANCO performed a short-term trend analysis of water quality by comparing the 1964-75 data to the 1975-76 data from the quality monitor on the Allegheny River at Oakmont (37). Temperature, pH and specific conductance showed no statistically significant changes but there was an increasing trend in the dissolved oxygen concentrations at the 0.001 level of significance.

TABLE 2.1.6.-25

STREAMS SHOWING WATER QUALITY IMPROVEMENTS (1973-1977)-
ALLEGHENY RIVER BASIN
SOURCE (25)

Year	Stream	County	Length Improved Miles	Reason for improvement
1973	Little Toby Creek	Jefferson	0.1	Sewage treatment
	Frencn Creek	Crawford	2.5	Sewage and industrial waste treatment
	French Creek	Venango	0.5	Industrial waste treatment
	Clarion River	Elk	1.0	Improved industrial waste treatment
	Allegheny River	Warren	20	Recovery from 1972 spill
	Allegheny River	Venango	8	Improved industrial waste treatment
	Lower Two Mile Run	Venango		Improved industrial waste controls
	Mason Creek	Elk	0.75	Landfill leachate problem corrected
	Allegheny River	*Warren	1.0	Industrial waste discharge stopped
	Tunungwant Creek	*McKean	2.0	Industrial connections to sewer system
	Oil Creek	Venango	1.0	Improved industrial waste treatment
	Caylor Run	Jefferson	1.0	Strip mine restoration
	Linesville Creek	Crawford	0.5	Industrial connection to sewer system
	Deer Creek	Allegheny	1.5	Landfill operation halted
	Pine Creek	Allegheny	1.5	Partial sealing of abandoned mine
	Little Conemaugh	Cambria	5	Coal refuse runoff treatment
	Saltlick Run	Cambria	5	Elimination of industrial discharge

*Erie, McKean, Potter and Warren Counties are not in the ORBES Region.

TABLE 2.1.6.-25 (Continued)

Year	Stream	County	Length Improved Miles	Reason for Improvement
	Stony Creek	Cambria	6	Sewage treatment
	Elk Creek	Cambria	8	Improved mine drainage treatment
	Big Conneautte Creek	*Erie	1.75	Improved sewage treatment
1974	Redbank Creek	Clarion-Armstrong border	3	Mine drainage abatement
	Mahoning Creek	Jefferson	2	Improved sewage treatment
	French Creek	Crawford	1	Improved industrial waste treatment
	Allegheny River	*Warren	1	Sewage treatment
	Crooked Creek	Indiana	19	Mine drainage abatement
1975	French Creek	Crawford	0.25	Industrial waste discharge abated
	Unnamed Tributary of Redbank Creek	Jefferson	0.5	Industrial waste discharge abated
	Mahoning Creek	Jefferson	2	Industrial waste discharge abated
	Elk Creek	Cambria	4	Mine drainage abatement
	Dutch Run/North Branch Blacklick Creek	Cambria	7	Improved industrial waste treatment
	South Branch Blacklick Creek	Cambria	3	Sewage treatment
	Pine Creek	Allegheny	8	Regionalized sewage treatment
	West Branch Deer Creek	Allegheny	3	Improved sewage treatment
	Allegheny River	Armstrong	1	Improved sewage treatment
1976	Little Paint Creek	Cambria	3.5	Sewage Treatment
	Stony Creek	Somerset	0.5	Sewage Treatment
	Wells Creek	Somerset	2.5	Sewage Treatment

*Erie, McKean, Potter and Warren Counties are not in the ORBES Region.

TABLE 2.1.6.-25 (Continued)

Year	Stream	County	Length Improved Miles	Reason for Improvement
	Allegheny River	Allegheny	2.6	Improved industrial waste treatment
	Little Plum Creek	Allegheny	4	Improved industrial waste treatment
	Haskins Run	Armstrong	2	Mine drainage abatement
	Cowanshannock Creek	Armstrong	11	Mine drainage abatement
	Kiskiminetas River	Armstrong & Westmoreland	1	Sewage treatment
	South Branch Bear Creek	Butler	1	Industrial discharge abated
	Pine Creek	Allegheny	3	Connections to regional sewer system
	French Creek	Crawford	0.5	Industrial connection to sewer system
	Tunungwant Creek	*McKean	0.5	Improved sewage treatment
	Allegheny River	Venango	0.5	Improved industrial waste treatment
	Allegheny River	*Warren	1.0	Improved sewage treatment
	South Branch Tionesta Creek	*Warren	0.25	Sewage treatment
	Unnamed Tributary of Caldwell Creek	*Warren	0.5	Sewage treatment
1977	Conemaugh River	Cambria	2.0	Industrial waste treatment & partial plant shut down
	Wells Creek	Somerset	0.5	Connection of industrial waste to municipal system
	Allegheny River	Armstrong	1	Sealing of mine
	Redbank Creek	Clarion	1	Improved sewage treatment
	Allegheny River	Venango	0.5	Industrial waste treatment
	Oil Creek	Venango	0.5	Industrial waste treatment
	Buck Lick Run & Chappel Fork	*McKean	3.5	Stream has recovered from 1976 crude oil spill

*Erie, McKean, Potter, and Warren Counties are not in the ORBES Region.

TABLE 2.1.6.-26

STREAMS SHOWING WATER QUALITY DEGRADATION (1973-1977)–
ALLEGHENY RIVER BASIN
SOURCE (25)

Year	Stream	County	Length Degraded Miles	Reason for Degradation
1973	Tributary to Buck Lick Run	*McKean	0.1	Siltation (oil drilling)
	Pine Creek	Allegheny	4.0	Industrial waste discharge
1974	Dutch Run and North Branch Blacklick Creek	Cambria	7	Mine drainage discharge
1975	Cooney Run	Indiana	3	Pesticide spill
1976	Sugar Run	Armstrong	2	Mine drainage
	Huling Run	Armstrong	3	Mine drainage
	Allegheny River	Armstrong	1	Breakout of mine seal
	Blacklick Run & Chappel Fork	*McKean	3.5	Crude Oil spill
	Allegheny River	*Potter	0.5	Overloaded sewage treatment plant
1977	Conemaugh River & Tributaries	Cambria	10.0	Johnstown flood
	Linesville Creek	Crawford	0.5	Spill of paint thinner
	East Sandy Creek	Clarion	1.5	Spill of wood preservative
	Mahoning Creek	Jefferson	1.5	Discharge of raw sewage due to flood
	Upper Sheriff Run	*McKean	0.5	Oil pipeline break
	Tunungwant Creek	*McKean	0.5	Overloaded secondary sewage facilities

*McKean and Potter Counties are not in the ORBES Region.

C. Ohio River Main Stem Basin

1. General

The waters of the Ohio River main stem and its tributaries in Pennsylvania, in their natural state, are moderately hard to hard, depending on the season of the year (36). However, the quality of the Ohio River is largely determined by three major factors:

(a) the contributions of the Allegheny and Monongahela Rivers;

(b) the waste residues discharged in the Pittsburgh metropolitan area; and

(c) the contributions of the tributaries below Pittsburgh.

In the 195's and 1960's many of the smaller tributaries carried substantial quantities of sulfuric acid into the Allegheny and Monongahela River, lowering their pH and, consequently, of the Upper Ohio River frequently to values less than 5.0 (30), (36). Various other changes in water quality are affected by municipal sewage, industrial wastes, and non-point runoff in the Pittsburgh metropolitan area. The average daily loads of various components contributed to the Ohio River by the Allegheny and Monongahela Rivers during the year October 1, 1974 - September 30, 1975 are summarized in Table 2.1.6.-27 (17). The Allegheny River contributed more load in most of the components, which can be expected because of its greater average flow. However, the loads of alkalinity, manganese, chloride and total phosphate were much greater than what could be due to the higher flow. On the other hand, the Monongahela River, in spite of its lower average flow, contributed greater loads of phenols and ammonia nitrogen.

The effect of the contributions from the Allegheny and Monongahela Rivers becomes more pronounce with decreasing discharges in the Ohio River: pH and dissolved oxygen are lowest, while the concentration of other com-

TABLE 2.1.6.-27

CONTRIBUTIONS TO THE OHIO RIVER BY THE ALLEGHENY AND MONONGAHELA RIVERS

SOURCE (17)

PARAMETER	AVERAGE DAILY LOAD (TONS/DAY)* DURING Oct. 1, 1964 - Sept. 30, 1965	
	FROM ALLEGHENY RIVER	FROM MONONGAHELA RIVER
Flow (cfs)	17,100	10,100
Dissolved Oxygen	572	314
Acidity (as $CaCO_3$)	153	151
Alkalinity (as $CaCO_3$)	554	198
Hardness (as $CaCO_3$)	3,900	2,910
Calcium	1,010	801
Magnesium	348	216
Manganese	46	21
Sulfate	4,500	4,020
Chloride	683	272
BOD	57	32
Total Iron	102	80
Phenols (pounds/day)	278	1,550
Surfactants (ABS)	2.5	1.8
Total Organic Carbon	272	191
Total phosphate	88	29
Sodium	555	502
Potassium	91	58
Ammonia-Nitrogen	7	15
Organic Nitrogen	22	17
Total Solids	12,500	8,740

*Except flow and phenols

ponents are usually highest during the low flow period of the year, generally in late September (14), (17), (36).

Significant changes in water quality are affected by the municipal and industrial wastes reaching the Ohio River from the Pittsburgh metropolitan area. Table 2.1.6.-28 summarizes the results of a study which evaluated the changes in loads of various components in the lower Allegheny River (Mile 45.1 to Pittsburgh Point), the lower Monongahela River (Mile 13.3 to Pittsburgh Point), and the upper Ohio River (Pittsburgh Point to Mile 25.2) during October 1, 1964 - September 30, 1965 (17). The results indicate that there was a general increase in the pollution loads in the waters of the three rivers as they proceed downstream through the study area (which comprised most of Allegheny County). Of major importance, at the time of study, was the great reduction in dissolved oxygen in the Ohio River which produced a critical reach below Pittsburgh where dissolved oxygen levels were often less than 4.0 mg/l during periods of low flows.

Conditions have greatly improved since 1965 due to increasing municipal and industrial pollution control in the basin (especially the upgrading of ALCOSAN to secondary treatment in 1974), and to low flow augmentation from storage reservoirs in the Allegheny and Monongahela River Basins (as discussed in previous sections). In 1974 the Corps of Engineers conducted a study on the effects of navigational dams on the water quality of the upper Ohio River. The Emsworth, Dashields, and Montgomery Dams were found to have an extremely beneficial effect on the dissolved oxygen concentration and it was recommended that the operation schedules of all spillway gates be re-examined to determine the feasibility of increasing aeration at low flows (38). The new operating procedures, since implemented, will probably result in further improvements in the dissolved oxygen levels in the Ohio River.

TABLE 2.1.6.-28 CHANGES IN MEAN STREAM LOADS IN THE PITTSBURGH, PA STUDY AREA (Tons/day, except Phenols) Source (17)

Parameter	Allegheny R. ΔA	Monongahela R. ΔB	Ohio R. ΔC	Total Study Area ΔD
Dissolved Oxygen	+65	+2	-91	-24
Acidity (as $CaCO_3$)	-272	-135	-47	-454
Alkalinity ($CaCO_3$)	-150	+93	+44	-13
Hardness ($CaCO_3$)	+702	+408	-111	+999
Calcium	+183	+143	+4	+330
Magnesium	+66	+12	-21	+57
Manganese	+2	+3	+1	+6
Sulfate	+789	+289	+296	+1,374
Chloride	+113	+100	+54	+267
BOD	-4	+6	+24	+26
Total Iron	+41	0	-2	+39
Phenols (lbs/day)	+86	+1,470	+289	+1,845
Surfactant	+0.8	+1.1	+3.0	+4.9
TOC	+51	+59	-15	+95
Total Phosphate	+27	-9	+1	+19
Sodium	+148	+131	+18	+297
Potassium	+16	+27	0	+43
Ammonia Nitrogen	-2	+10.6	+7	+15.6
Organic Nitrogen	+11	+7	-7	+11
Total Solids	+3,955	+2,283	-2,883	3,335

ΔA = Difference in mean daily loads between the Allegheny River at its mouth and the sum of the loads in the Allegheny River at Kittanning, PA and in the Kiskiminetas River at Apollo, PA.

ΔB = Difference in mean daily loads between the Monongahela River at its mouth and the sum of the loads in the Monongahela River at Belle Vernon, PA and in the Youghiogheny River at West Newton, PA.

ΔC = Difference in mean daily loads between the Ohio River at Rochester, PA and the sum of the loads from the Allegheny and Monongahela Rivers.

ΔD = Total net change of average daily loads in study area = ΔA + ΔB + ΔC.

The major industrial sources of wastes reaching the upper Ohio River in the greater Pittsburgh area are the basic steel and metal finishing industries, inorganic and organic chemical manufacturing, coking, and power plants. These and the municipal waste sources and their treatment will be discussed in more detail in Section 2.1.6.5.

Mine drainage from bitumenous coal mining operations as well as municipal and industrial wastes also reach the Ohio River through many of its tributaries in Pennsylvania. The major tributary is the Beaver River which also receives the flow of the polluted Mahoning River from Ohio.

There are four reservoirs in the headwater areas of the tributaries to the Beaver River which provide partial low flow augmentation which has some effect on the water quality of the Ohio River in Pennsylvania. Three of these: Berlin, Mosquito Creek, and West Branch Mahoning Reservoirs are located in Ohio and are operated by the Corps of Engineers to improve the water quality in the Mahoning River Valley, particularly at Youngstown. Shenango Reservoir on the Shenango River immediately above Sharpsville, PA, stores 29,900 acre-feet of inflow for release during the summer month to improve the water quality in the Shenango and Beaver Rivers (32).

2. Surface Water Quality

The yearly averages and ranges of temperature, conductivity, dissolved oxygen and pH are shown for the Ohio River at South Heights, PA in Figure 2.1.6.-29. The average monthly values of the same parameters for the last eight years at the same station are shown in Figure 2.1.6.-30. Similar information for the Beaver River at Beaver Falls, PA, is presented in Figures 2.1.6.-31 and 2.1.6.-32. The data for these four figures were calculated from ORSANCO's Robot Monitor Computer Printouts (6).

The mean values of selected parameters for a twelve-year period (June 1962 through December 1974) at the PA WQN Stations in the basin are presented

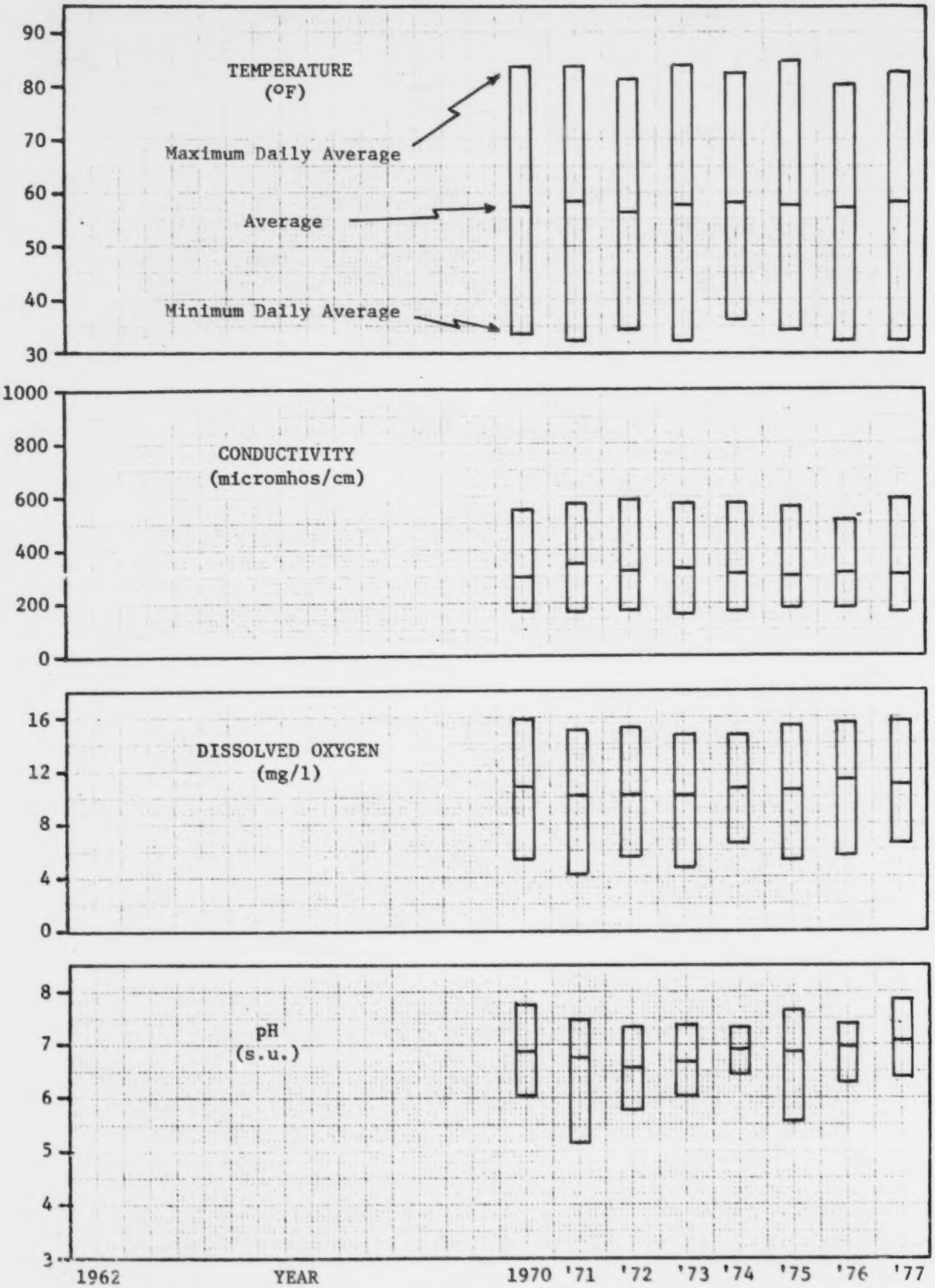


FIGURE 2.1.6.-29 ANNUAL WATER QUALITY -- OHIO RIVER AT SOUTH HEIGHTS (6)

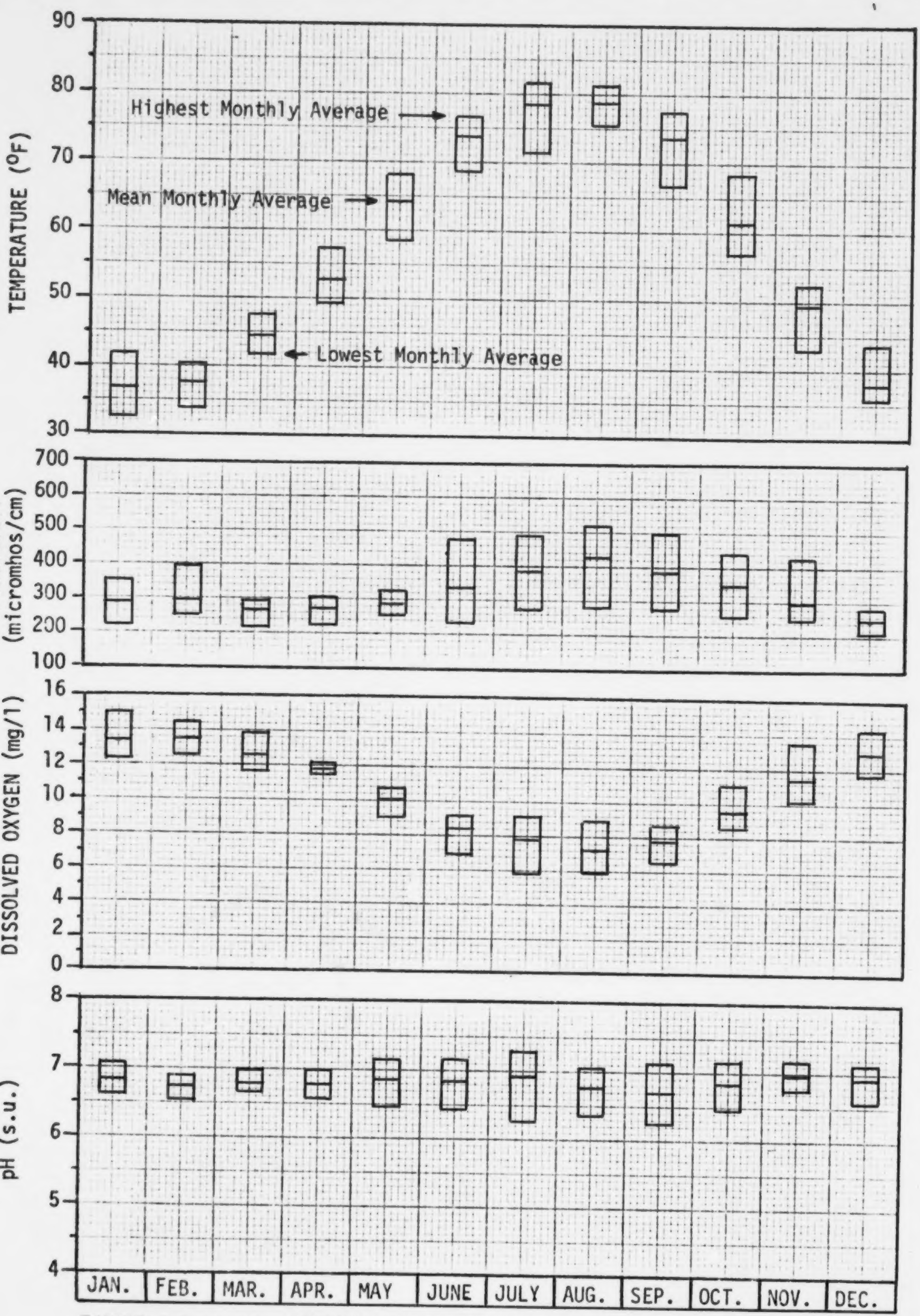


FIGURE 2.1.6.-30 SEASONAL VARIATION OF WATER QUALITY: MONTHLY AVERAGES - OHIO RIVER AT SOUTH HEIGHTS, 1970-77 After Source (6)

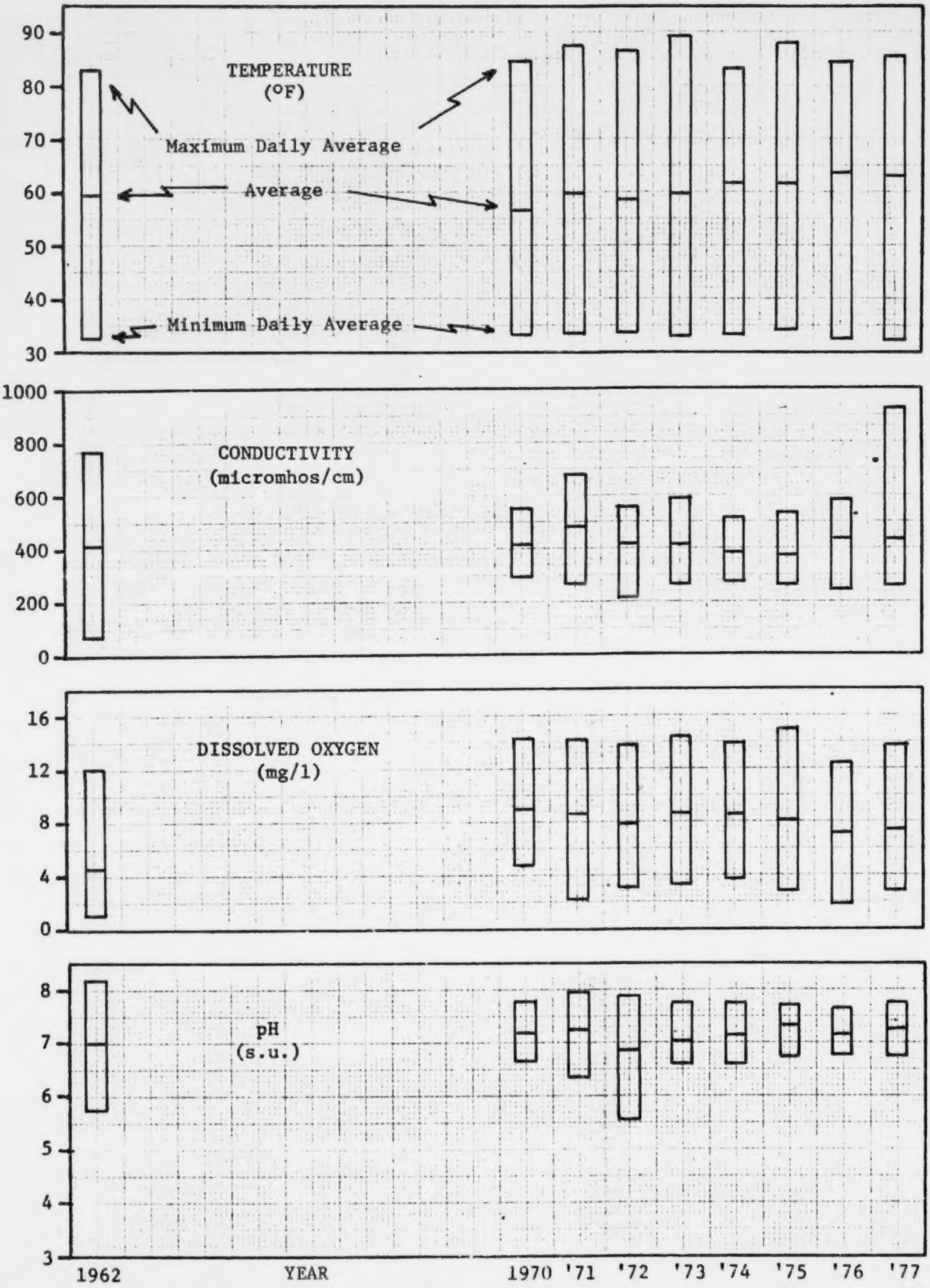


FIGURE 2.1.6.-31 ANNUAL WATER QUALITY -- BEAVER RIVER AT BEAVER FALLS (6)

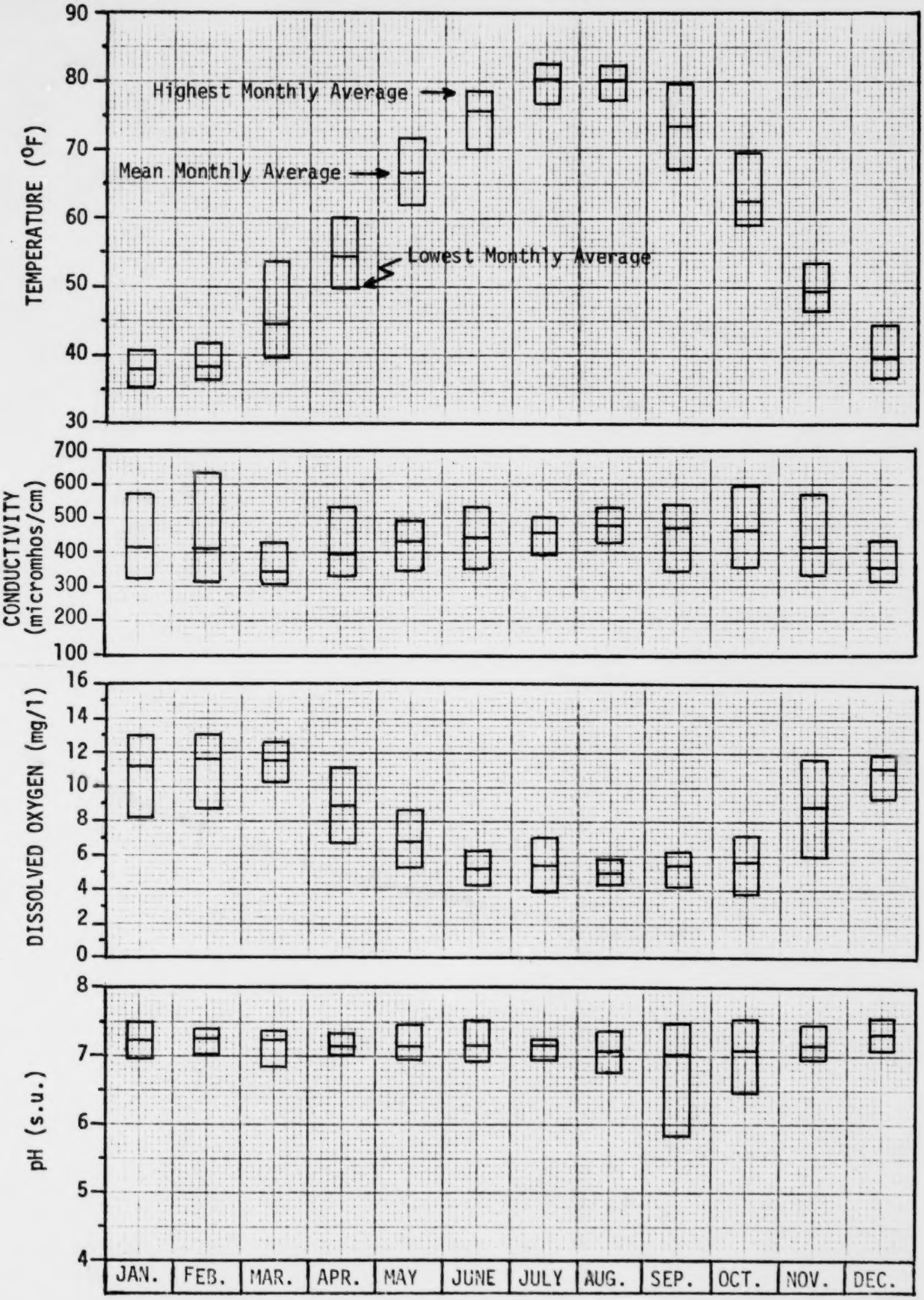


FIGURE 2.1.6.-32 SEASONAL VARIATION OF WATER QUALITY: MONTHLY AVERAGES – BEAVER RIVER AT BEAVER FALLS, 1970-77 After Source (6)

in Table 2.1.6.-29 (2). More detailed information for the 1975-1977 period at the two stations on the Ohio River and one on the Beaver River is presented in Table 2.1.6.-30, as obtained from EPA's STORET System. Similarly detailed information on water quality at the two ORSANCO stations in the basin is presented for 1977 in Table 2.1.6.-31 (39).

3. Water Quality Problems

The major water quality problems in the Ohio River Main Stem Basin are due to acid mine drainage, municipal sewage and industrial wastes. These problems and their specific causes are detailed for the streams affected in Table 2.1.6.-32 (1), (2), (25), (26). The COWAMP classification and the miles of streams degraded by the problems are also presented in the Table.

4. Compliance Status

Table 2.1.6.-33 compares the 1975 water quality at the WQN Stations in the basin with the 1974 State standards (1), (2), (25), (26).

Average dissolved oxygen levels were within standards at all stations but the minima were below the standard in the Ohio River and several other streams as well. Mean pH was unsatisfactory in Raccoon and Slippery Rock Creeks only, but many other streams were occasionally either were either lower or higher than the standard for the minimum or maximum pH. Temperature was a proble in the Beaver River and some of its tributaries. Most widespread violation of the standards was obtained for total iron and fecal coliform.

ORSANCO assessed the water quality of the Ohio River main stem and its major tributaries and compared the conditions during July 1, 1975 - June 30, 1976 with ORSANCO's stream quality criteria (or with ORBC's where ORSANCO criteria were not available) (37). Several parameters were found to violate the criteria as summarized in the table below. Parameters not

TABLE 2.1.6.-29

MEAN VALUES OF SELECTED PARAMETERS AT SAMPLING STATIONS IN THE OHIO RIVER MAIN STEM BASIN

(Data Collected from June 1962 to December 1974)

Source (2)

Parameter	River						
	Ohio River		Beaver River		Shenango River		Little Shenango River
	Sampling Station (PA-DER WQN No.)						
	901	902	904	905	909	910	913
pH (S.U.)	6.7	6.5	7.3	7.3	6.7	6.9	6.8
Dissolved Oxygen (mg/l)	9.8	8.9	8.8	8.2	8.2	12.5	10.8
Total Iron (ug/l)	2,463	2,262	1,288	1,832	2,176	814	916
Total Dissolved Solids (mg/l)	73	50	172	111	169	146	164
Temperature (°C)	12.7	12.8	14.3	14.1	14.1	12.3	10.9
Turbidity (JTU)	19.3	16.3	16.8	16.9	17.6	14.3	10.2
Ammonia (mg/l N)	0.29	0.88	0.35	0.66	0.31	0.24	0.14
Total Phosphorus (mg/l P)	0.11	ND	0.22	0.20	0.23	0.09	0.05
Alkalinity (as $CaCO_3$) (mg/l)	25.2	13.1	57.2	57.8	51.7	53.9	77.4
Biochemical Oxygen Demand (mg/l)	2.8	1.9	4.4	8.5	3.8	2.4	2.0
Total Coliform (#/100 ml)	39,000	28,300	69,000	57,900	82,400	10,600	37,700

TABLE 2.1.6.-30 OHIO AND BEAVER RIVER WATER QUALITY, 1975-1977

(From EPA's STORET System)

Parameter	WQN Station No. 901 Ohio River at East Liverpool				WQN Station No. 902 Ohio River at Ambridge				WQN Station No. 905 Beaver River at Eastvale			
	No. of Samples	Mean Value	Maximum Value	Minimum Value	No. of Samples	Mean Value	Maximum Value	Minimum Value	No. of Samples	Mean Value	Maximum Value	Minimum Value
Water Temperature, ^{o}C	25	13.8	27.0	0.5	23	12.1	25.0	0.5	21	16.4	27.0	1.0
Flow, cfs	--	--	--	--	--	--	--	--	4	6,505	11,400	4,359
Turbidity, JTU	11	10.9	39.0	2.9	10	16.6	85.0	3.0	13	10.2	33.0	3.6
Conductivity at $25^{o}C$, micromhos/cm	25	345	530	175	22	325	490	200	22	472	610	335
Dissolved Oxygen, mg/l	21	10.6	15.0	6.6	18	10.3	13.5	5.8	20	8.7	14.0	3.4
pH, Standard Units	24	7.1	7.6	6.8	21	7.1	7.8	6.3	22	7.4	8.6	6.8
Total Alkalinity, mg/l as $CaCO_3$	25	29	70	14	22	27	70	12	24	64	110	17
Mineral Acidity, mg/l	24	0	0	0	22	0	0	0	24	0	0	0
Acidity from CO_2, mg/l	25	0.16	4	0	22	0	0	0	23	0.52	12	0
Total Residue, mg/l	--	--	--	--	--	--	--	--	--	--	--	--
Dissolved/105^{o} Residue, mg/l	25	373	4,062	100	21	242	1,034	112	23	294	448	121
Total Nonfilterable Residue, mg/l	--	--	--	--	--	--	--	--	--	--	--	--
Settleable Residue, ml/l	--	--	--	--	--	--	--	--	--	--	--	--
Oil and Grease, mg/l	22	4.9	17.0	0.5	21	3.7	5.8	0.5	2	4.8	8.6	1.0
Total NH_3-N, mg/l	25	0.46	1.40	0.20	22	0.47	2.20	0.10	24	0.60	1.80	0.10
Total NO_2-N, mg/l	24	0.031	0.140	0.002	21	0.024	0.120	0.002	22	0.082	0.410	0.002
Total NO_3-N, mg/l	22	0.81	1.59	0.13	18	0.68	1.50	0.01	20	1.43	3.05	0.43
Total Phosphorus, mg/l P	25	0.13	0.25	0.03	21	0.14	0.34	0.03	23	0.20	0.66	0.09
Total Cyanide, mg/l	25	0.02	0.10	0.01	21	0.03	0.23	0.01	21	0.025	0.100	0.006
Total Hardness, mg/l as $CaCO_3$	26	112	180	30	22	104	157	60	24	164	225	115
Dissolved Calcium, mg/l	25	31.4	49.5	7.7	22	28.0	44.6	17.8	24	45.7	58.1	34.0
Dissolved Magnesium, mg/l	25	8	14	1	22	8.5	20.0	2.8	24	11.7	27.0	2.6
Chloride, mg/l	26	22	40	8	22	19.3	40.0	10.0	24	41	75	21
Total Sulfate, mg/l	25	101	440	36	22	118	680	48	24	92	295	50
Total Fluoride, mg/l	--	--	--	--	--	--	--	--	--	--	--	--
Total Arsenic, mg/l	3	0.043	0.100	0.010	2	0.010	0.010	0.010	3	0.040	0.100	0.010
Total Cadmium, mg/l	4	0.010	0.020	0.001	3	0.007	0.010	0.001	3	0.010	0.010	0.010
Total Chromium, mg/l	4	0.040	0.050	0.008	3	0.025	0.050	0.004	3	0.050	0.050	0.050
Total Copper, mg/l	4	0.040	0.050	0.010	3	0.022	0.050	0.006	3	0.037	0.050	0.010
Total Iron, mg/l	26	1.604	6.000	0.250	22	1.450	10.500	0.002	23	2.752	43.000	0.250
Total Lead, mg/l	4	0.058	0.100	0.010	3	0.060	0.100	0.030	3	0.053	0.100	0.010
Manganese, mg/l	5	0.380	0.800	0.160	4	0.895	2.400	0.260	3	0.200	0.300	0.100
Total Nickel, mg/l	4	0.043	0.050	0.020	3	0.040	0.050	0.020	3	0.050	0.050	0.050
Total Zinc, mg/l	4	0.040	0.060	0.010	3	0.050	0.070	0.030	3	0.093	0.180	0.050
Total Aluminum, mg/l	5	0.640	2.100	0.100	4	0.950	2.000	0.100	3	0.233	0.300	0.100
Total Coliforms, no./100 ml	--	--	--	--	--	--	--	--	--	--	--	--
Fecal Coliforms, no./100 ml	26	591	3,500	20	18	982	6,000	20	19	3,903	20,000	20
Total Phenols, mg/l	25	0.014	0.063	0.002	20	16.7	74.0	2.0	20	0.012	0.095	0.002
Total Mercury, mg/l	2	0.0008	0.0010	0.0005	2	0.0005	0.0005	0.0005	3	0.0007	0.0010	0.0005

TABLE 2.1.6.-31 OHIO AND BEAVER RIVER WATER QUALITY, 1977

Source (39)

	Parameter	Ohio River at South Heights				Beaver River at Beaver Falls			
		No. of Samples	Maximum Value	Minimum Value	Average Value	No. of Samples	Maximum Value	Minimum Value	Average Value
From Electronic Monitor	Arsenic, micrograms/liter	4	2	1		4	10	1	
	Barium " "	12	110	20		12	90	10	
	Cadmium " "	11	6	1		12	5	1	
	Chromium " "	12	24	4		12	16	4	
	Copper " "	12	24	8		12	112	6	
	Cyanide " "	35	70	10		36	60	10	
	Iron " "	12	6,500	400		12	4,500	650	
	Lead " "	12	35	3		12	50	10	
	Manganese " "	12	800	40		12	500	180	
	Mercury " "	12	0.5	0.5		12	0.5	0.5	
	Nickel " "	12	40	10		12	40	10	
	Phenol " "	35	63	2		36	40	2	
	Selenium " "	4	5	1		4	5	1	
	Silver " "	4	1	1		4	1	1	
	Zinc " "	12	210	20		12	170		
	Fecal Coliform, number/100 ml	31	213,000	150		31	20,000	50	
	Water Temperature, °F	Cont.	82.7		56.9	Cont.	86.2		57.9
	pH	Cont.	7.9	6.3		Cont.	8.2	6.6	
	Specific Conductance, micromhos/cm	Cont.	608		305	Cont.	949		436
	Sodium, mg/l	11	30	10	19	11	42	15	27
	Sulfate, mg/l	35	245	48	90	36	233	44	83
	Suspended Solids, mg/l	34	162	2	34	35	81	2	22
	5-Day BOD, mg/l	11	4.8	2.0	2.8	10	7.4	2.0	3.9
	Ammonia-N, mg/l	35	1.9	0.10	0.49	36	3.3	0.25	0.91
	Nitrate-N, mg/l	35	1.76	0.06	0.72	36	1.70	0.69	1.20
	Total Phosporus, mg/l	35	0.52	0.04	0.15	36	0.48	0.10	0.23
	Total Kjeldahl-N, mg/l	35	6.6	0.5	1.5	36	6.3	0.7	2.1
	Dissolved Oxygen, mg/l	Cont.		6.2	10.89	Cont.		2.2	7.17
	Dissolved Oxygen, % saturation	Cont.	128	62		Cont.	109	28	
From WUN*	Total Hardness, mg/l					104	218	102	154
	Non-Carbonate Hardness, mg/l					104	138	35	84
	Sulfate, mg/l					47	150	52	100
	Alkalinity, mg/l					365	97	36	70
	Chloride, mg/l					104	141	21	43
	Turbidity, standard units					365	320	6	20
	Threshold Odor Number, standard units					365	100	30	77

*Water Users' Network

TABLE 2.1.6.-32 CLASSIFICATION AND QUALITY PROBLEMS OF MAJOR STREAMS - OHIO RIVER MAIN STEM BASIN

Sources (1), (2), (25), (26)

Stream	Stream Segment	CO-WAMP Sub-Basin	Class (a)	Category (b)	Problems	Causes of Problems (Parameter Group Violation) (c)	Miles of Stream Degraded By Problems
Pymatuning Lake	Shoreline	20A			Erosion and sedimentation	Sewer line construction (4)	11
Shenango River	Above Pymatuning Reservoir	20A	WQL	I	Phosphorus, taste and odor		20
	Below Pymatuning Reservoir	20A	WQL	I	Taste and odor, solids, Fe, oil, pH, fecal coliforms, CN, NH_3, phenol, DO, temperature	Combined sewers, industrial discharges, nonpoint sources (1, 2, 3, 4, 5)	
Mahoning River	State line to mouth	20B	WQL	I		Domestic & industrial wastes in Ohio	
Beaver River	Entire watershed	20B	WQL	I	Combined sewers, fecal coliforms, temperature, heavy metals, phenol, cyanides, oil and grease	Depressed water quality due to influx of Mahoning River which received substantial industrial waste discharges in Ohio. Organic loadings due to raw and inadequately treated sewage discharges (1, 2, 3, 4, 5)	10
Wallace Run		20B				Industrial waste and runoff (1, 4, 5)	2
Two Mile Run	Downstream from Westinghouse Industries	20B			Degradation in water quality and reduction of aquatic diversity and population downstream due to elevated heavy metal concentrations	Industrial waste (1, 4, 5)	2
Brady Run, South Branch	Watershed above Brady Run Dam	20B	WQL	I	Phosphorus		
Brady Run	Downstream from reservoir	20B			Siltation	Clay mine drainage (1, 4, 5)	2
North Fork Little Beaver Creek	Entire stream length	20B	EL	I	High dissolved solids, stream bed siltation	Runoff from extensive coal and fire clay strip mining operation in past. Moderate stripping still carried on (1, 4, 5)	1
Ohio River	Pittsburgh Point to state line	20B, G	WQL	I	Fecal coliform, oil, heavy metals	Combined sewers, industrial waste discharges, urban runoff, (1, 2, 3, 4, 5)	33
Thorn Creek		20C				Inadequately treated sewage and leachate from malfunctioning septic system in Penn Twp. and from Saxonburg STP (2, 3, 4)	2
Breakneck Creek		20C				The Mars STP is not providing tertiary treatment as required by the upgrade notice (2, 3, 4)	2

TABLE 2.1.6.-32 (Continued)

Stream	Stream Segment	CO-WAMP Sub-Basin	Class (a)	Category (b)	Problems	Causes of Problems (Parameter Group Violation) (c)	Miles of Stream Degraded By Problems
Little Connoquenessing Creek		20C			Fe, pH, sulfate	Localized problem due to mine drainage from tributaries (1, 4, 5)	2
Connoquenessing Creek	Entire watershed above Slippery Rock Creek	20C	WQL	I	BOD, NH_3, oil, suspended solids, heavy metals, sulfate	Industrial wastes, inadequately treated sewage (1, 2, 3, 4)	10
Muddy Creek	Entire watershed	20C	WQL	I	Phosphorus		
Brush Creek		20C				Mine drainage and inadequately treated sewage result in water quality problems under low flow conditions (2, 4)	1
Slippery Rock Creek	Entire watershed	20C	AMD	I	pH, iron, siltation, dissolved solids	Headwaters severely degraded by acid mine drainage due to extensive mining in Butler County area. Occasional siltation and increased suspended solids due to active limestone mining operations in vicinity of McConnel Mills Park (1, 4, 5)	7
Mulligan Run		20C				Strip mining activities responsible for water quality degradation (1, 4, 5)	10
Semiconan Run							
Yellow Creek							
Glade Run		20C	AMD	I		Sewage, acid mine drainage	
Wolf Creek	Entire watershed	20C	WQL	I	BOD, NH_3, phosphorus	Water treatment backwash sludge	
Cross Creek	Watershed including North Fork, from North Fork to Mouth	20D	AMD	I		Acid mine drainage	
Harmon Creek	Entire watershed	20D	AMD	I	Severely depressed	Acid mine drainage	
Little Raccoon Creek	Entire watershed	20D				Seepage from industrial waste disposal site. Runoff from coal refuse piles degrade one of the tributaries (1 4, 5)	6
Burgetts Fork	Reach between Slovan-Atlasburg and the stream mouth	20D			Severely degraded	Acid mine drainage, as well as raw and inadequately treated sewage discharges from the communities along the stream (1, 2, 3, 4, 5)	10
Raccoon Creek	Lower 40 miles	20D	AMD	I		Abandoned and active strip mines (1, 4, 5)	63
Potatoe Garden Run	Entire watersheds						
Brush Run							
Dilloe Run							
Cross Creek							

TABLE 2.1.5.-32 (Continued)

Stream	Stream Segment	CO-WAMP Sub-Basin	Class (a)	Category (b)	Problems	Causes of Problems (Parameter Group Violation) (c)	Miles of Stream Degraded By Problems
Service Creek	Watershed above Service Creek Dam	20D	WQL	I	Phosphorus		
Traverse Creek	Watershed above State Park Dam	20D	WQL	I	Phosphorus		
Dutch Fork Buffalo Creek	Watershed above Dutch Fork Dam	20E	WQL	I	Phosphorus		
Wheeling Creek, North Fork	Watershed above Ryerson Station Dam	20E	WQL	I	Phosphorus		
Saw Mill Run	Entire watershed	20F	WQL	I		Water quality is adversely affected by acid mine drainage, illegal discharge from unsewered homes and storm water runoff, solid waste (1, 2, 3, 4, 5)	9.5
Chartiers Creek	Entire watershed above Allegheny-Washington County Line	20F	WQL	I	BOD, NH_3, combined sewers, fecal coliform, heavy metals	Middle reach between Washington and Cannonsburg affected by inadequately treated sewage discharges. Lower reach from Bridgeville to the mouth contains high concentrations of iron due to abandoned mine drainage. Industrial waste discharges in Washington area and urban runoff (1, 2, 3, 4, 5)	35
	Watershed from Allegheny-Washington County Line to mouth	20F	AMD	I	Oil, combined sewers, suspended solids, fecal coliform, heavy metals, dissolved oxygen		
Robinson Run	Entire watershed	20F	WQL	I	Poor quality	Raw and inadequately treated sewage; acid mine drainage (1, 2, 3, 4, 5)	16
Brush Run	Lower reach	20F	WQL	I		Inadequately treated sewage overflows (2, 3, 4)	1
Millers Run	Entire watershed	20F	WQL	I		Cecil and Mt. Pleasant Twp. areas affected by raw and inadequately treated sewage discharges. Lower reach affected by acid mine drainage and industrial wastes (1, 2, 3, 4, 5)	8
Ohio River, Tributaries of	Point to Big Sewickley Creek, except Chartiers Creek	20F, G	WQL	I	BOD, NH_3, suspended solids, oil, combined sewers		
Montour Run	Headwaters upstream from Imperial	20G	WQL	I		Raw and inadequately treated sewage and acid mine drainage from coal stripping operations (1, 2, 3, 4, 5)	5.5
Moon Run	Entire length	20G	WQL	I		Sewage, abandoned mine drainage (1, 4 5)	5
Big Sewickley Creek	Entire watershed	20G	WQL	I	Suspended solids, BOD, NH_3 heavy metals	Industrial wastes	

NOTES: **(a) CLASSES:**
WQL = Water Quality Limited Stream
EL = Effluent Limited Stream
AMD = Acid Mine Drainage Affected Stream

(b) CATEGORIES: See definition in Section 2.1.6.4.

(c) PARAMETER GROUPS:
1 = Harmful substances (heavy metals, chemicals, pesticides, other toxins)
2 = Oxygen depletion
3 = Eutrophication potential (phosphorus, nitrogen)
4 = Physical modification (temperature, turbidity, suspended solids, color, flow)
5 = Salinity, acidity, alkalinity (conductivity, pH, alkalinity, total dissolved solids)

TABLE 2.1.6.-33 COMPLIANCE STATUS 1975 - OHIO RIVER MAIN STEM BASIN

Sources (1), (2), (25), (2

GENERAL INFORMATION								SPECIFIC WATER QUALITY PARAMETERS							POTENTIAL PROBLEMS						
Station No.	Stream	Class (a)	Category (b)	CO-WAMP Sub-basin	County	Criter Stand. Group (c)	Average Flow cfs	pH S.U.	D.O. mg/1	TOT.Fe mg/1	TEMP. °C	TDS mg/1	ODOR S.U.	Total Colif. /100ml	ALL VALUES GIVEN AS mg/1					Overall Quality Rating	Will Stream Meet Water Quality Standards By 1983?
								mean/max.													
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)	(19)	(20)	(21)	(22)
901	Ohio River	EL	I	20D	Beaver	B+h, k,1,q	10650	OK/ 5.4	OK	2.5/ 11.2	OK	OK	26/27	39000/ 366800	Phenol .030/ .300	Al OK/4.0	Zn .135/ .140	SO_4 OK/336	CN OK/40	Fair	No. Direct discharges expected to be corrected, but combined sewers in the Pittsburgh metropolitan area will still have adverse affects.
902	Ohio River	WQL	I	20G	Allegheny	B+h, k,1,q	35257	OK/ 5.3	OK/ 1.0	2.2/ 13.6	OK	OK	30/53	70100/ 804600	Phenol .040/ .190	Al 8.6/77	SO_4 OK/390	Mn OK/4.0		Fair to good	
903	Racoon Creek	EL	I	20D	Beaver	B	141	5.2/ 3.4-9	OK/ 3.5	5.5/ 20	OK	OK/ 1716		28300/ 297000	Al 16.5/84	Zn .180/ .180	Ni .480/ .480	SO_4 660/ 1900	Mn 4.6/7.4	Poor	No. Some cleanup is expected with use of funds previously allocated to Chartiers Creek.
904	Beaver River	EL	I	20B	Beaver	B+h,q	5551	OK/ 8.8	OK	OK/ 4.0	OK	OK	25/37	69200/ 390000	Phenol OK/.062	Zn .110/ .110				Poor	No. Sewage problem will be corrected; industrial waste problems may remain due to lack of control over discharges in Ohio.
905	Beaver River	EL	I	20B	Beaver	B+h,q	3259	OK/ 9.0	OK/ 3.6	1.8/ 18.0	OK/32	OK	28/34	57900/ 503300	Al 4.2/31	Pb .053/ .060	SO_4 OK/386				
906	Beaver River	EL	I	20B	Lawrence	B	1741	OK	OK/ 2.2	2.2/ 12.0	---	OK		57000/ 454000	Phenol .033/ .078						
907	Connoquenessing Creek	WQL	I	20C	Beaver	B	394	OK/ 8.8	OK	OK/ 9.1	OK	OK		30500/ 460000	Al 3.5/21	SO_4 OK/495				Poor	Yes.
908 (e)	Slippery Rock Creek	WQL	I	20C	Lawrence	A-b_1 +b_9	435	OK	OK/ 5.8	OK/ 6.0	OK/ 24	OK		10900/ 100000	Phenol .038/ .142					Good	No. Lack of funds for mine drainage projects.
909	Shenango River	EL	I	20A	Lawrence	B+h,q	6	OK	OK/ 3.0	2.2/ 7.4	OK	OK	28/35	82400/ 930000	Zn .114/ .130						Yes.

NOTES: (a) Classes: WQL = Water Quality Limited Stream
EL = Effluent Limited Stream
AMD = Acid Mine Drainage Affected Stream

(b) Categories: See definition in text, Section 2.1.6.4.
(c) 1974 Pa. Water Quality Criteria Groups and Levels as defined in Reference (28).
(d) Data Source: USGS Water Resources Bulletin No. 1.
(e) Discontinued.

TABLE 2.1.6.-33 (Continued)

GENERAL INFORMATION								SPECIFIC WATER QUALITY PARAMETERS							POTENTIAL PROBLEMS						
Station No.	Stream	Class (a)	Category (b)	CO-WAMP Sub-basin	County	Criter Stand. Group (c)	Average Flow cfs	pH S.U.	D.O. mg/l	TOT.Fe mg/l	TEMP. °C	TDS mg/l	ODOR S.U.	Total Colif. /100ml	ALL VALUES GIVEN AS mg/l					Overall Quality Rating	Will Stream Meet Water Quality Standards By 1983?
								mean/max.													
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)	(19)	(20)	(21)	(22)
910	Shenango River	EL	I	20A	Mercer	B+h, q	768	OK	OK	OK/ 3.4	OK	OK	39/45	10600/ 180000	SO_4 OK/425	Cu .107/ .194	Ni .166/ .306	Zn .085/ .129		Fair	Yes.
913	Little Shenango River	WQL	II	20A	Mercer	$C+v_1$	262	OK/ 5.8	OK	OK/ 10.5	OK	OK		37700/ 540000	Tot. Alk.as $CaCO_3$ OK/174						
914	Chartiers Creek	WQL	I	20F	Allegheny	$B-b_2$ $+b_5$	233	OK/ 4.4-10	OK/ 1.0	17.1/ 100	OK	OK/ 1500		55800/ 350000	Phenol .024/ .100	Al 15/.104	Zn .305/ .350	Ni .290/ .330	SO_4 305/ 350	Fair to poor	Not entirely. Approx. 18 miles in middle reach will meet standards by 1983; 17 miles in lower reach will violate standards due to mine drainage discharges and lack of funds for abatement and treatment, and difficulties in acquiring land on which to build acid drainage abatement facilities.
916	Chartiers Creek	WQL	I	20F	Washington	$B-b_2$ $+b_3$		OK	OK	OK/2.5	OK	OK			Zn .1[illegible]/ .120	SO_4 419/ 1450	Tot. Alk. 138/ 158				
915	Mahoning River	EL	I	20B	Lawrence	$B-d_2+$ d_5,h, 1,m,q		OK	OK/0	3.2/ 10.0	OK/33	OK	34/45		CN .027/ .145	Phenol .052/ .255	SO_4 OK/280	Mn OK/ 1.25	Zn 387/387	Poor	
917	Connoquenessing Creek	WQL	I	20C	Butler	B	23.8 (d)	OK	OK	OK/ 2.8	OK	OK			Zn .080/ .090	Ni .105/ .210	SO_4 OK/395			Depressed downstream from Butler, Eidenave, Zelienople; fair to good on remainder	Yes.

NOTES: (a) Classes: WQL = Water Quality Limited Stream
EL = Effluent Limited Stream
AMD = Acid Mine Drainage Affected Stream

(b) Categories: See definition in text, Section 2.1.6.4.
(c) 1974 Pa. Water Quality Criteria Groups and Levels as defined in Reference (28).
(d) Data Source: USGS Water Resources Bulletin No. 1.
(e) Discontinued.

TABLE 2.1.6.-33 (Continued)

GENERAL INFORMATION								SPECIFIC WATER QUALITY PARAMETERS							POTENTIAL PROBLEMS						
Station No.	Stream	Class (a)	Category (b)	CO-WAMP Sub-basin	County	Criter Stand. Group (c)	Average Flow cfs	pH S.U.	D.O. mg/l	TOT.Fe mg/l	TEMP. °C	TDS mg/l	ODOR S.U.	Total Colif. /100ml	ALL VALUES GIVEN AS mg/l					Overall Quality Rating	Will Stream Meet Water Quality Standards By 1983?
								mean/max.													
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)	(19)	(20)	(21)	(22)
918	Two Mile Run	EL	I	20B	Beaver	B	---	OK	OK	OK/ 11.2	OK	OK			Zn .260/ .260						Yes.
919 (e)	Brush Creek	EL	I	20C	Beaver	B	481 (d)	OK	OK	1.7/ 5.6	OK	OK								Fair	Yes.
920	Glade Run	WQL	I	20C	Butler	B		OK	OK	OK/ 2.3	OK	OK			Zn .100/ .100					Good to excellent	
921	Slippery Rock Creek	WQL	I	20C	Butler	$A-b_1$, $+b_9$	20 (d)	OK	OK	OK/ 4.8	OK/23	OK		---						Good	No. Lack of funds for mine drainage projects.
922	Slippery Rock Creek	WQL	I	20C	Lawrence	$A-b_1$, $+b_9$	564 (d)	8.6/ 8.6-8.7	OK	OK/ 1.8	25/25	OK			SO_4 OK/296						
923	North Fork Little Beaver Creek	EL	I	20B	Lawrence	A		OK	OK	OK/ 2.2	24/24	780/ 1132		65300/ 287500	SO_4 444/ 1652					Good	Yes.
924 (e)	Big Run	EL	I	20A	Lawrence	B	2 (d)														

NOTES: (a) Classes: WQL = Water Quality Limited Stream
EL = Effluent Limited Stream
AMD = Acid Mine Drainage Affected Stream

(b) Categories: See definition in text, Section 2.1.6.4.
(c) 1974 Pa. Water Quality Criteria Groups and Levels as defined in Reference (28).
(d) Data Source: USGS Water Resources Bulletin No. 1.
(e) Discontinued.

listed were either not sampled or were not violated at any time.

Parameter	% of Samples (or Time) which Violated ORSANCO's (or ORBC's) Stream Quality Criteria in 1975-1976	
	Ohio River at South Heights	Beaver River at Beaver Falls
Dissolved Oxygen	0	31
pH	3	0
Total Suspended Solids	8	3
Fecal Coliform		
for Recreation	100	100
for Water Supply	0	50
Total Phosphorus	38	100
Phenol	0	3
Cyanide	8	6
Total Iron	67	45

Due to drainage from abandoned mines in the basin, some effluent limitations have been postponed on Cross, North Fork Cross, and Harmon Creeks (35).

According to a recent report, over three-quarter of the stream length in the basin meets standards but, within the basin, four-fifth of the Connoquenessing-Slippery Rock Creek watershed and about half of the Ohio's main stem is satisfactory, while practically none of Chartiers Creek's main stem or Saw Mill Run is meeting standards (29).

DER estimates that with increasing municipal and industrial pollution control, most of the Ohio River probably will meet the standards by 1983 and many of the problems on the tributaries will be eliminated or reduced. Nevertheless, acid mine drainage, combined sewer overflow, urban runoff and other non-point sources will remain unabated in the near future (29).

5. Stream Quality Changes, 1973-1977

Table 2.1.6.-34 lists the length of improved stream miles and Table 2.1.6.-35 the length of degraded stream miles in the basin during the five-year period of 1973-77 (25).

A trend analysis was was performed for the major water quality parameters by comparing the 1953-75 (long-term) and the 1964-75 (short-term) data with the July 1, 1975 - June 30, 1976 data from ORSANCO's monitors. Available data in Pennsylvania allowed the short-term trend analysis only, the results of which are summarized below (37).

Parameter	Short-Term Trend	
	Ohio River at South Heights	Beaver River at Beaver Falls
Water Temperature	N.S.	N.S.
Dissolved Oxygen	Increasing (0.001)	N.S.
Total Coliform		Decreasing (0.001)
Threshold Odor		Increasing (0.001)
Turbidity		Decreasing (0.01)
pH	Increasing (0.001)	Increasing (0.05)
Alkalinity		Increasing (0.01)
Specific Conductance	N.S.	N.S.
Total Hardness		Decreasing (0.001)
Non-Carbonate Hardness		Decreasing (0.001)
Chloride		N.S.

N.S. = No statistically significant trend
(In parentheses): level of significance

TABLE 2.1.6.-34
STREAMS SHOWING WATER QUALITY IMPROVEMENTS (1973-1977) - OHIO RIVER BASIN
SOURCE (25)

YEAR	STREAM	COUNTY	LENGTH IMPROVED MILES	REASON FOR IMPROVEMENT
1973	Otter Creek	Mercer	0.5	Sewage treatment
	McCauley Run and Shenango River	Mercer	2	Improved industrial waste controls
	Shenango River	Lawrence	2.0	Improved industrial waste treatment
	Lardingtown Run	Butler	3	Strip mine reclamation
	Tributary to North Fork of Little Beaver Creek	Beaver	2	Improved industrial waste treatment
1974	Slippery Rock Creek	Lawrence	2	Improved sewage treatment
	Beaver River	Lawrence	5	Closing of industrial plant
	Shenango River	Mercer	2	Industrial discharge phased out
	Raccoon Creek	Beaver	12	Mine drainage abatement
1975	Ohio River	Allegheny and Beaver	40	Improved sewage treatment
	Chartiers Creek	Allegheny	1	Industrial waste discharge abated
	Millers Run	Allegheny	3	Sewage discharge abated
	Breakneck Creek	Butler	2	Improved sewage treatment
1976	Big Sewickley Creek	Allegheny & Beaver	0.5	Improved industrial waste treatment
	Montour Run	Allegheny	1	Sewer system connection
	Breakneck Creek	Butler	1	Industrial waste treatment
	Beaver River	Beaver	3.5	Improved sewage treatment
	Beaver River	Lawrence	0.25	Improved sewage treatment
	Ohio River	Beaver	4	Industrial waste treatment
	Walnut Bottom Run	Beaver	0.5	Sewer system connection
	Mill Run	Mercer	0.5	Sewage treatment
	Shenango River	Mercer	5	Sewage & industrial waste treatment

TABLE 2.1.6.-34 (Continued)

YEAR	STREAM	COUNTY	LENGTH IMPROVED MILES	REASON FOR IMPROVEMENT
1977	Chartiers Creek	Washington	4.0	Sewer connection to treatment facility
	Little Raccoon Creek	Washington	0.5	Treatment facility for refuse pile mine drainage
	Raccoon Creek	Beaver	40.0	Treatment facility & cleanup operation at industrial facility
	State Line Creek	Beaver	2.0	New treatment facility in Ohio-discharge in Penna. abated
	Connoquenessing Creek	Lawrence	1.0	Improved sewage treatment
	Wolf Creek	Mercer	1.0	Industrial waste treatment
	Unnamed Tributary of Munnelt Run	Mercer	3.0	Sewage treatment
	Unnamed Tributary of Squaw Run	Lawrence	1.0	Sewage treatment

TABLE 2.1.6.-35
STREAMS SHOWING WATER QUALITY DEGRADATION (1973-1977) - OHIO RIVER BASIN
SOURCE (25)

YEAR	STREAM	COUNTY	LENGTH DEGRADED MILES	REASON FOR DEGRADATION
1973	Little Beaver River	Lawrence	1.0	Industrial waste discharge
1976	Little Connoquenessing Creek	Butler	9	Mine drainage
	Semiconon Run	Butler	2	Mine drainage
	Chartiers Creek	Washington	1	Overloaded sewage treatment plant
	Brush Run (Chartiers Creek)	Washington	1	Overloaded sewage treatment plant
1977	Peggs Run	Beaver	1.5	Coal discharge stock piles & treatment plant
	Ohio River	Beaver	2.0	Discharge of fuel oil from storm sewer
	Pymatuning Lake	Crawford	11.0	Erosion & sedimentation problems due to sewer
	McClure Run	Lawrence	1.5	Spill of industrial waste
	Shenango River	Lawrence	15.0	Industrial waste discharge
	Unnamed Tributary to Neshannock Creek	Lawrence	0.5	Fish kill due to industrial waste spill

2.1.6.5. TREATMENT AND DISCHARGE OF WASTEWATERS

A. Municipal Wastewaters

Wastewater originates from residential, commercial and industrial water users and also from stormwater flows. Industrial and urban stormwaters contain a variety of potential pollutants but the major impact on the water quality is from pollutants present in residential and commercial sewage.

The existing Pennsylvania requirements governing wastewater treatment are contained in Chapter 95 of the Department of Environmental Resources "Rules and Regulations" (12). However, revisions were proposed in March 1978 (11) and although they have not been adopted the new formulation is probably a more accurate guide of requirements which will apply to the ORBES Region. Table 2.1.6.-36 sets forth the existing wastewater requirements and Table 2.1.6.-37 outlines the proposed revisions. The revisions are more stringent. They place responsibility for justifying any exception to the protection of high quality waters on the discharger. Also, any new development discharging into high quality waters would need to utilize best available, rather than best practicable, technology. A new section on waste load allocations provides the department greater flexibility to address the problems of (a) nonattainment of quality criteria in some stream sections, and (b) the lack of knowledge of the impact of some pollutants. Similarly the concept of land disposal has received emphasis which was absent in the preceding regulations.

Primary, secondary and tertiary treatment levels are mentioned extensively with reference to wastewater treatment. The Department of Environmental Resources actually established eight treatment level classifications which are defined in terms of the expected effluent concentrations of the most important water parameters (2). Table 2.1.6.-38 lists the eight treatment levels and the expected concentration of the four water parameters corresponding to them. Colifrom bacteria are maintained at low concentrations by

TABLE 2.1.6.-36

EXISTING WASTE WATER TREATMENT REQUIREMENTS
Source (12), (40)

TITLE 25. RULES AND REGULATIONS
PART I. DEPARTMENT OF ENVIRONMENTAL RESOURCES
Subpart C. PROTECTION OF NATURAL RESOURCES
ARTICLE II. WATER RESOURCES

CHAPTER 95. WASTE WATER TREATMENT REQUIREMENTS

Authority

The provisions of this Chapter 95 issued under act of June 22, 1937, P.L. 1987, § 5 (35 P.S. § 691.5.).

Source

The provisions of this Chapter 95 adopted June 1977.

---

§ 95.1 General requirements.

(a) Specific treatment requirements and effluent limitations for each waste discharge shall be established based on the most stringent of subsection (b) of this section, the water quality criteria specified in Chapter 93 of this title (relating to water quality criteria), the applicable treatment requirements and effluent limitations to which a discharge is subject under the Federal Water Pollution Control Act, as amended (33 U.S.C. §§ 1251 et seq.) or the treatment requirements and effluent limitations of this title.

(b) Waters having a better quality than applicable water quality criteria as of the effective date of the establishment of such criteria shall be maintained at such high quality unless it is affirmatively demonstrated that a change is justified as a result of necessary economic or social development and will not preclude uses presently possible in such waters.

(c) Any industrial, public or private project or development which would constitute a new source of pollution or an increased source of pollution to high quality waters shall be required to provide the highest and best practicable means of waste treatment to maintain high water quality.

(d) In implementing the provisions of subsection (b) and (c) of this section, the Department shall keep the Administrator of the Environmental Protection Agency advised and shall provide him with such information as he will need to discharge his responsibilities under the Federal Water Pollution Control Act (33 U.S.C. 1151 et seq.).

TABLE 2.1.6.-36 (Continued)

§ 95.2 Waste treatment requirements.

(a) All wastes shall be given a minimum of secondary treatment.

(b) Secondary treatment for sewage, except discharges from the bodies of animals, is that treatment which shall accomplish the following:

(1) Reduce the organic waste load as measured by the biochemical oxygen demand test by at least 85% during the period May 1 to October 31, and by at least 75% during the remainder of the year based on a five consecutive day average of values.

(2) Remove practically all of the suspended solids.

(3) Provide effective disinfection to control disease producing organisms.

(4) Provide satisfactory disposal of sludge.

(5) Reduce the quantities of oils, greases, acids, alkalis, toxic, taste and odor producing substances, color and other substances inimical to the public interest to levels which shall not pollute the receiving stream.

(c) Secondary treatmentfor other wastes is that treatment which achieves either of the following:

(1) The effluent limitations resulting from the application of the "best practicable control technology currently available" as defined by the Administrator of the United States Environmental Protection Agency pursuant to Sections 301, 304, and 402 of the Federal Water Pollution Control Act (33 U.S.C. §§ 1311, 1314, and 1342); or

(2) For those discharges for which "best practicable control technology currently available" has not been defined by the Administrator under the Federal Water Pollution Control Act (33 U.S.C. §§ 1251 et seq.), effluent limitations resulting from the Department of Environment Resources' determination of the equivalent of "best practicable control technology currently available".

TABLE 2.1.6.-36 (Continued)

§ 95.3 Reserved.

§ 95.4. Discharge to acid stream.

(a) Where wastes are discharged to a stream polluted by coal mine drainage from abandoned mines to the extent that all the alkalinity of the stream has been exhausted and the pH of the stream is 4.0 or less at practically all times at the point of discharge and throughout the stream, a minimum of primary treatment or its equivalent for industrial wastes shall be provided to bio-degradable wastes.

(b) A minimum of secondary treatment shall be required on such streams where:

(1) the quality of the water in the receiving stream is expected to improve significantly due to a scheduled program for abatement of pollution from abandoned mines; or

(2) the primary treated effluent would cause pollution in downstream waters.

(c) Primary treatment is that treatment which shall accomplish the following:

(1) Remove practically all the settleable solids.

(2) Remove at least 35% of the organic pollution load as measured by the biochemical oxygen demand test.

(3) Provide effective disinfection to control disease producing organisms.

(4) Provide satisfactory disposal of sludge.

(5) Reduce the quantities of oils, greases, acids, alkalis, toxic-, taste-, and odor-producing substances, color and other substances inimical to the public interest to levels that will not pollute the receiving stream.

§ 95.5. Effective disinfection.

Effective disinfection to control disease producing organisms shall be the production of an effluent which will contain a concentration not greater than 200/100 ml of fecal coliform organisms as a geometric average value nor greater than 1,000/100 ml of these organisms in more than 10% of the samples tested.

§ 95.6. Change in treatment requirements.

(a) Whenever there is a change in the provisions of Chapter 93 (relating to water quality criteria) or this Chapter or whenever the department adopts a plan or makes a determination that would change existing or impose additional water quality criteria or treatment requirements, it shall be the duty of the permittee of facilities affected thereby, upon notice from the department, to promptly take such steps as shall be necessary to plan, obtain a permit or other approval, and construct such facilities as may be required to comply with the new water quality criteria or treatment requirements.

(b) Within ninety (90) days of the receipt of such notice, or within such lesser period as the department may specify, the permittee shall submit to the department either a report establishing that its existing facilities are capable of meeting the new water quality criteria or treatment requirements or a schedule setting forth the nature and date of completion of steps that shall be necessary to plan, obtain a permit or other approval, and construct facilities to comply with the new water quality or treatment requirements. The permittee shall comply with the schedule as approved by the department.

TABLE 2.1.6.-37 PROPOSED REVISIONS TO WASTE WATER TREATMENT REQUIREMENTS AS OF MARCH 1978

Source (11)

Material proposed to be added to an existing rule or regulation is printed in **bold face** and material proposed to be deleted from such a rule or regulation is enclosed in brackets **[—]** and printed in **bold face**. Proposed new or additional regulations are printed in standard type face.

Chapter 95. Wastewater Treatment Requirements

§ 95.1. General Requirements.

(a) Specific treatment requirements and effluent limitations for each waste discharge shall be established based on the more stringent of subsections (b) **and (c)** of this section, the water quality criteria specified in Chapter 93 of this title (relating to water quality **[~~criteria~~] standards**), the applicable treatment requirements and effluent limitations to which a discharge is subject under the Federal Water Pollution Control Act, as amended (33 U.S.C. §§ 1251 *et seq.*) or the treatment requirements and effluent limitations of this title [~~.~~]; **and such treatment requirements and effluent limitations shall be incorporated by the Department into permits and orders issued under The Clean Streams Law (35 P. S. §§ 691.1-691.1001) and into certifications issued under the Federal Water Pollution Control Act.**

(b) Waters having **[~~a better water quality than the applicable water quality criteria as of the effective date of establishment of such criteria~~] a water use designated as "High Quality Waters" in § 93.9(b) of this title (relating to designated water uses and water quality criteria)** shall be maintained and protected at **[~~such high quality~~] their existing quality**, unless **[~~it is~~] the following are** affirmatively demonstrated **[~~that a change is justified as a result of necessary economic or social development and will not preclude uses presently possible in such waters.~~] by a proposed discharger of sewage, industrial wastes, or other pollutants:**

(1) the proposed new, additional, or increased discharge or discharges of pollutants is justified as a result of necessary economic or social development which is of significant public value; and

(2) such proposed discharge or discharges, alone or in combination with any other anticipated discharges of pollutants to such waters, will not preclude any use presently possible in such waters and downstream from such waters and will not result in a violation of any of the numerical water quality criteria specified in § 93.9 (b) of this title for such waters or for any other of the waters of this Commonwealth.

(c) **[~~Any industrial, public or private project or development which would constitute a new source of pollution or an increased source of pollution to high quality waters shall be required to provide the highest and best practicable means of waste treatment to maintain high quality.~~] Waters having a water use designated as "Exceptional Value Waters" in § 93.9(b) of this title (relating to designated water uses and water quality criteria) shall be maintained and protected at a minimum at their existing quality.**

(d) **[~~In implementing the provisions of subsections (b) and (c) of this Section, the Department shall keep the Administration of the Environmental Protection Agency advised and shall provide him with such information as he will need to discharge his responsibilities under the Federal Water Pollution Control Act (33 U.S.C. § 1151 et seq.).~~] Any project or development which would result in a new, additional, or increased discharge or discharges of sewage, industrial wastes, or other pollutants into waters having a water use designated as "High Quality Waters" in § 93.9(b) of this title (relating to water quality criteria) shall be permitted only in compliance with the requirements of subsection (b) of this section and, furthermore, shall be required to do either of the following:**

(1) utilize the best available combination of treatment and land disposal technologies and practices for such wastes where such land disposal would be economically feasible, environmentally sound, and consistent with all other regulations in this title,

(2) if such land disposal is not economically feasible, is not environmentally sound, or cannot be accomplished consistent with all other regulations of this title, utilize the best available technologies and practices for the reuse and discharges of such wastes.

§ 95.3. [Reserved] Waste load allocations.

(a) Waste load allocations are specific daily limits on the discharge of wastes from point sources as opposed to requirements of minimum waste treatment performance as specified elsewhere in this title.

(b) Waste load allocations are an administrative device to allow the Department to determine effluent limitations necessary to protect water quality and to treat waste dischargers equitably and will normally be implemented by their inclusion as effluent limitations in permits, orders, NPDES permit certifications, or similar Departmental actions concerning point source discharges.

(c) Waste load allocations do not establish a transferable property right; that is, the discharger cannot transfer his allocation to another discharger. The Department may transfer a waste load allocation when a permit is transferred provided that no violations of this title exist.

(d) Waste load allocations will be made by the Department when the following conditions prevail:

(1) Water quality criteria for stream section, segment, or zone are not being achieved, even though discharges to such section, segment, or zone are being treated to meet the minimum treatment requirements specified in Chapters 93, 95 and 97 of this title or the Federal Water Pollution Control Act, 33 U.S.C.A. §§ 1251-1276.

(2) Water quality criteria for a stream section, segment, or zone may not be achieved during periods of accepted design stream flow, as identified in § 93.5(b) of this title (relating to designated water uses specific water quality criteria), even if existing or anticipated discharges to such section, segment, or zone were treated to meet the minimum treatment requirements specified elsewhere in this title.

(3) Minimum treatment requirements have not been established for a particular pollutant.

(e) In making a waste load allocation, the Department will determine the stream section, segment, or zone and the pollutant for which a waste load allocation is needed. The Department will also determine the maximum allowable daily load ("MDL") of the pollutant from point and nonpoint sources which the receiving waters can assimilate at the accepted design stream flow without endangering the achievement of water quality criteria or water uses.

(f) In determining the MDL, the Department will do the following:

(1) Determine whether the pollutant in question is a persistent or nonpersistent-decaying-substance. The Department will treat all pollutants as persistent unless it finds, on the basis of information available to it, that the substance is nonpersistent.

(i) For persistent substances, the MDL shall be calculated on the basis that instream concentrations of the substance are determined solely by dilution in the receiving waters.

(ii) For nonpersistent substances, the Department will determine and specify, in writing, the mechanism by which the substance decays in the stream, including mathematical equations or formulae used to describe such instream decay.

(2) Provide a margin of safety which takes into account:

(i) any lack of knowledge concerning the relationship between effluent limitations and water quality including any uncertainty or imprecision in mathematical models utilized to determine this relationship; and

(ii) in the case of a nonpersistent substance, any imprecision or uncertainty concerning the mechanism by which the substance decays in the stream.

(3) Determine what portion of the MDL shall be attributed to nonpoint sources and what portion to point sources. In making this determination, the Department will consider a specific allowance for anticipated economic and population growth over a period of at least ten years.

TABLE 2.1.6.-37 (Continued)

(g) The portion of the MDL which is determined to be attributable to point sources shall be the maximum daily allowable load ("MAL") and shall be equitably allocated among existing and proposed point source discharges in the form of effluent limitations specifying maximum daily quantities of the pollutant in question that may be discharged from each such point source, subject, however, to the following:

(1) A portion, not less than 10%, of the MAL shall be reserved as an allowance for anticipated economic and population growth over at least a five-year period, including an additional allowance reflecting the precision and validity of the method used to estimate such population and economic growth.

(2) The pollutant loadings allocated to individual point sources are compatible with achieving and maintaining water quality criteria and protecting existing or possible beneficial uses at each discharge point.

(3) The Department may specify daily average quantity effluent limitations, as well as average and maximum concentration limitations, in addition to any daily maximum quantity limitation allocated to a particular point source.

(h) Whenever a mathematical modeling technique is utilized to determine the MDL or to describe instream decay of a nonconservative substance, the modelling technique selected should represent the minimum level of sophistication and complexity needed to provide for waste load allocations.

(i) The Department will revise the waste load allocation for a stream segment using the procedures described in this section if the Department determines that the reserve specified in subsection (g) (1) of this section will be exhausted or whenever it deems it necessary to do so. Allocations not used will be returned to the reserve.

(j) Whenever a permit, order, certification, or other Departmental action specifies an effluent limitation for a particular point source which is based on a waste load allocation, the Department may also require appropriate monitoring of the receiving waters and reporting of such monitoring data to the Department unless the Department makes a specific finding that such monitoring would be redundant.

(k) The Department may request any present or potential dischargers of any pollutant for which a waste load allocation is being made under this section to supply information concerning any of the factors specified in this section as well as any waste load allocation model or formula such discharger may have developed for waste load allocation. If the discharger fails to submit the requested information within 30 days or such longer period as the Department may specify in writing, such discharger shall be deemed to have waived its right to contest in any forum, the factors, formulae, and models used by the Department in the waste load allocation.

(l) Where the Department determines that the procedures specified in this section are inappropriate for making a waste load allocation for a particular stream segment, it may adopt a revised method of waste load allocation for that segment, provided it publishes the substance of such proposed revised method in the Pennsylvania Bulletin and solicits comments thereon.

§ 93.4. Location of waste discharges.

(a) Wastewater discharge effluent limitations relating to the water quality criteria of Chapter 93 of this title (relating to water quality standards) shall be established so as to attain and maintain those criteria and shall be calculated upon the assumption of complete mixing of the discharge effluent with the receiving waters at the point of discharge, based upon an allocated portion of the design stream flow.

(b) Wastewater discharge effluent limitations described in subsection (a) of this section shall be determined as follows:

(1) They shall be established so as to provide for the maintenance and propagation of a balanced community of aquatic life, animal life, and waterfowl in and on the receiving waters, and so as to prevent pollution as defined in section 1 of the Clean Streams Law (35 P. S. § 691.1).

(2) They shall be calculated, at a minimum, so as to insure that the discharge will at no time cause the applicable water quality criteria to be violated in areas described as follows:

(i) Outside an area greater than ½ the width, or more than ⅓ the vertical cross-sectional area of the receiving waters at the point of discharge.

(ii) Outside an area, in any direction from the point of discharge, equal to 10% of the surface of any receiving reservoir or inland lake except Lake Erie, where the area shall not exceed 12 acres:

(iii) In any hypolimnetic waters of any inland lake or reservoir, waters which serve as a migratory route for any species of aquatic life, waters contributing to a drinking water supply intake; or any waters within a bathing place permitted pursuant to the Public Bathing Law, (35 P. S. §§ 672-680d).

(iv) In waters which constitute or interface with the spawning areas of aquatic life.

(3) They shall, at no time, allow for a change in the temperature of the receiving waters at any point by more than 2°F. in any one-hour period or result in mortality of any indigenous fish species.

(c) The phrase, "allocated portion of the design stream flow," shall be defined, for purposes of this section, as that portion of the accepted design stream flow, as set forth in § 93.5 of this title (relating to application of water quality criteria to discharge of pollutants), of the receiving waters which is selected by the Department for use in calculating water quality criteria-related effluent limitations; provided that no portion shall be allocated to more than one discharge.

§ ~~[95.4]~~ 95.5. Discharge to acid stream.

* * * * *

§ 95.6. Discharge to lakes, ponds, and impoundments.

(a) Except where otherwise specified in the Department's waste-water management implementation plans, new discharges or expanded or upgraded existing discharges to watersheds and their tributaries that flow into lakes, ponds, and reservoirs more than 25 acres in surface area or more than 15 feet maximum depth, or both, and that have 30 days or more detention time based on average daily flow shall be treated or otherwise abated to remove phosphorus such that the total phosphorus in the discharge does not exceed 0.5 mg/l as P. The Department will determine, on a case-by-case basis, the proximity to the lake, pond, or reservoir that shall require these special phosphorus controls.

(b) Land disposal of wastes should be utilized wherever feasible to prevent the discharge of nutrients into lakes, ponds, or reservoirs.

§ ~~[95.5]~~ 95.7. Effective disinfection.

* * * * *

§ ~~[95.6]~~ 95.8. Change in treatment requirements.

(a) If there is a change in the provisions of Chapter 93 (relating to water quality ~~[criteria]~~ **standards**) or this Chapter or whenever the Department adopts a plan or makes a determination that would change existing or impose additional water quality criteria or treatment requirements, it shall be the duty of the permittee of facilities affected thereby, upon notice from the Department, to promptly take steps as shall be necessary to plan, obtain a permit or other approval, and construct such facilities as may be required to comply with the new water quality ~~[criteria]~~ **standards** or treatment requirements.

(b) Within 90 days of the receipt of such notice [.] or within such lesser period as the Department may specify, the permittee shall submit to the Department either a report establishing that its existing facilities are capable of meeting the new water quality ~~[criteria]~~ **standards** or treatment requirements or a schedule setting forth the nature and date of completion of steps that shall be necessary to plan, obtain a permit or other approval, and construct facilities to comply with the new water quality or treatment requirements. The permittee shall comply with the schedule as approved by the Department.

TABLE 2.1.6.-38

TREATMENT LEVELS AND THEIR CORRESPONDING EXPECTED EFFLUENT CONCENTRATIONS

Source (2)*

Treatment Level Classification	Parameter (mg/1)											
	BOD			NH_3-N			TOT P			TSS		
	30 day avg.	7 day avg.	daily max.	30 day avg.	7 day avg.	daily max.	30 day avg.	7 day avg.	daily max.	30 day avg.	7 day avg.	daily max.
(1) No treatment	No effluent concentrations have been designated for these four treatment levels.											
(2) Less than Primary												
(3) Primary												
(4) Intermediate												
(5) Secondary	30	45	60	-	-	-	-	-	-	30	45	60
(6) Secondary & High BOD + NH_3 Removal	10-30	10-30	20-60	1.5-9.0	1.5-9.0	3-18	-	-	-	25-30	25-30	50-60
(7) Tertiary	10	10	20	1.5-9.0	1.5-9.0	3-18	0.5-1.0	0.5-1.0	1-2	25	25	50
(8) Tertiary & Other	<10	<10	<10	<1.5	<1.5	<3	<0.5	<0.5	<1	<25	<25	<50

*Original source: DER Bureau of Water Quality Management, Pittsburgh Regional Office

BOD - Biochemical Oxygen Demand

NH_3-N - Ammonia Nitrogen

TOT P - Total Phosphorus

TSS - Total Suspended Solids

chlorination in combination with the various treatment levels.

The bulk of the population in the ORBES Region is served by municipal wastewater facilities and some are served by non-municipal facilities such as septic tanks. Inventories of the municipal facilities are available in Chapter VII, Appendix A, Study Areas #8, and #9, of the COWAMP study for Pennsylvania (1), (2). Maps showing the location of the facilities are available in the COWAMP reports for Areas #8, #9, #5, and #6 {(1), (2), (3), and (4)}. (The overlap of the COWAMP Study Areas with the ORBES Region was described in Section 2.1.6.1.)

The municipal facilities' inventories in COWAMP list the facilities individually and tabulate the location, facility owner, population served (design and actual), wastewater flow (design and actual), treatment provided, and the name, condition, and classification of the receiving stream. Additional relevant data (e.g. wastewater characteristics) are listed in a separate table for the major facilities. A summary of municipal facilities in COWAMP Study Areas #8 and #9 is presented in Table 2.1.6.-39. This groups the number of facilities, population served and level of treatment provided by county. Table 2.1.6.-40 gives a similar summary for non-municipal facilities. These include treatment such as septic tanks, Imhoff tanks, stabilization ponds, extended aeration, activated sludge, and sand filtration. Five non-municipal facilities in COWAMP Area #9 have flows that exceed 0.25 million gallons per day and they comprise 25% of the area's non-municipal flow. In Area #8, non-municipal facilities serve less than half the population that is so served in Area #9. In addition, four of the counties in Area #8 do not belong to the ORBES Region.

The volume of wastewater discharged to a receiving stream is an important aspect of the water quality of rivers. The heaviest concentration of wastewater treatment plants occurs, as one would expect, in urban areas and the

TABLE 2.1.6.-39

MUNICIPAL FACILITIES SUMMARY: COWAMP AREA #8

Source (1)

County	No. Facilities*	Actual Pop. Served	Treatment Provided*							
			Primary		Secondary		Tertiary		Other	
			No. Facilities	Population Served	No. Facilities	Population Served	No. Facilities	Population Served	No. Facilities	Population Served
Clarion	9	18,000	1	350	6	15,200	0	0	1(L),1(R)	2,450
Crawford**	10	47,000	1	8,000	8	35,600	0	0	1(R)	3,000
Elk	3	22,000	0	0	3	22,000	0	0	-	0
Forest	2	3,000	0	0	0	3,000	0	0	2(R)	0
Jefferson	7	27,000	2	6,000	4	19,800	0	0	1(R)	1,200
Lawrence	7	79,000	3	9,000	4	70,000	0	0	-	0
McKean**	9	41,000	0	0	6	39,000	0	0	2(L),1(R)	2,000
Mercer	13	89,000	3	24,500	9	64,000	0	0	1(R)	500
Potter**	3	6,000	0	0	2	5,000	0	0	1(R)	1,000
Venango	7	42,000	3	19,000	4	23,000	0	0	-	0
Warren**	4	22,000	0	0	4	22,000	0	0	-	0
Total	74	396,000	13	66,850	50	318,600	0		8(R),3(L)	10,150
% of Total	100	-	18	17%	67	81%	0		11(R),4(L)	2%

(R) - Raw
(L) - Lagoons

* Assuming that all proposed treatment facilities currently have raw discharges due to either population concentrations or non-municipal facilities malfunctions.

** Crawford, McKean, Potter and Warren Counties are not in the ORBES Region.

TABLE 2.1.6.-39 (Continued)

MUNICIPAL FACILITIES SUMMARY: COWAMP AREA #9

Source (2)

County	Number of Facilities(a)	Actual Population Served	Treatment Provided							
			Primary		Secondary		Tertiary		Other (c)	
			# of Facilities	Population Served	# of Facilities	Population Served	# of Facilities	Population Served	# of Facilities	Population Served
Allegheny	96	1,760,000	8	182,000	75	1,560,000	10	4,000	3(L) 7(R)	2,000 12,000
Armstrong	4	25,000	2	7,500	2	7,500	0	-	6(R)	10,000
Beaver	25	168,000	4	54,600	19	110,400	2	2,000	2(R)	1,000
Butler	14	73,000	0	-	12	72,300	0	-	2(L) 9(R)	700 -
Fayette	22	146,000	3	19,000	18	69,300	1	200	25(R)	57,500
Greene	8	14,000	4	4,000	4	7,000	0	-	5(R)	3,000
Indiana	4	39,000	1	5,226	3	29,133	0	-	6(R)	4,641
Washington	22	186,000	2	27,900	18	135,408	2	558	12(R)	22,134
Westmoreland	47	297,000	3	64,746	28	136,026	15	53,460	1(L) 31(R)	1,485 41,283
Total	242	2,708,000	27	364,972	179	2,127,067	30	60,218	6(L) 103(R)	4,185 151,558
% of Total (b)	54%	94%(d)	6%	13.5%	40%	78.5%	7%	2.2%	1%(L) 46%(R)	0.2% 56.0%

(a) These numbers do not include raw discharges.
(b) These numbers include raw discharges (i.e. (R) + No Facilities = Total)
(c) (R) = Raw, (L) = Lagoons
(d) Based on 1970 population of 2,875,000 [p. V-6]

TABLE 2.1.6.-40

NON-MUNICIPAL FACILITIES SUMMARY: COWAMP AREA #8

Source (1)

County	No. Facilities	Actual Pop. Served	Treatment Provided: Septic Tank		Septic Tank/ Sand Filtration		Stabilization Pond		Extended Aeration		Extended Aeration/ Advanced Treatment*		Other	
			No. Facilities	Pop. Served	No. Facilities	Pop. Served	No. Facilities	Pop. Served	No. Facilities	Pop. Served	No. Facilities	Pop. Served	No. Facilities	Pop. Served
Clarion	19	4,800	0	0	4	560	5	1,110	9	3,080	0	0	1(a)	50
Crawford**	36	25,700	0	0	4	240	4	650	15	17,100	10	6,750	2(b),1(g)	960
Elk	4	1,100	0	0	0	0	0	0	4	1,100	0	0	0	0
Forest	5	7,300	0	0	1	100	1	300	2	6,500	1	400	0	0
Jefferson	6	6,400	0	0	4	5,100	0	0	2	1,300	0	0	0	0
Lawrence	36	13,300	1	900	5	1,915	7	765	13	4,940	6	1,980	1(b),1(c), 1(d),1(g)	2,800
McKean**	4	1,400	0	0	0	0	0	0	4	1,400	0	0	0	0
Mercer	58	28,400	0	0	12	2,500	18	11,200	15	4,600	10	6,940	1(b),1(g), 1(h)	3,160
Potter**	7	2,300	0	0	1	10	1	50	4	940	1	1,300	0	0
Venango	29	13,800	0	0	6	775	5	1,100	9	4,050	3	3,000	1(b),1(d), 1(e),1(i), 2(g)	4,875
Warren**	26	10,300	1	~260	12	1,600	0	0	9	3,800	2	1,100	1(b),1(f)	3,800
Total	230	114,800	2	1,160	49	12,800	41	15,175	86	48,810	33	21,470	19	15,645
% of Total	100%	-	1%	1%	21%	11%	18%	13%	38%	42%	14%	19%	8%	14%

* Advanced Treatment is defined as microstraining, sand filtration, or stabilization ponds.

(a) no information
(b) trickling filter
(c) contact stabilization
(d) no treatment
(e) stabilization pond/polishing pond
(f) septic tank/sand filtration & advanced treatment
(g) extended aeration/polishing pond
(h) sand filtration & advanced treatment
(i) stabilization pond/sand filtration

**Crawford, McKean, Potter and Warren Counties are not in the ORBES Region.

TABLE 2.1.6.-40 (Continued)

NON-MUNICIPAL FACILITIES SUMMARY: COWAMP AREA #9

Source (2)

County	Number of Facilities	Actual Population Served	Treatment Provided: Septic Tank/ Imhoff Tank		Imhoff Tank or Advanced Treatment		Stabilization Pond		Extended Aeration		Extended Aeration Advanced Treatment*		Imhoff Tank/ Trickling Filter		Activated Sludge		Sand Filtration		Other	
			# of Fac.	Pop. Served	# of Fac.	Pop. Served	# of Fac.	Pop. Served	# of Fac.	Pop. Served	# of Fac.	Pop. Served	# of Fac.	Pop. Served	# of Fac.	Pop. Served	# of Fac.	Pop. Served	# of Fac.	Pop. Served
Allegheny	80	49,100	4	5,175	17	3,617	0	-	32	12,798	14	6,212	6	6,470	0	-	1	1,200	2(b) 1(j) 2(c) 1(g)	13,628
Armstrong	23	9,200	0	-	1	74	0	-	11	5,140	7	2,940	0	-	2	276	0	-	2(c)	770
Beaver	38	19,400	0	-	3	155	2	349	23	8,168	4	4,38[illegible]	0	-	2	2,910	1	97	1(a) 1(g) 1(b)	3,337
Butler	59	44,400	0	-	7	710	9	1,776	25	10,434	13	4,795	1	266	0	-	0	-	1(d) 1(c) 1(b) 1(l)	26,419
Fayette	54	26,600	1	1,000	14	2,240	0	-	28	17,522	7	5,116	1	335	0	-	0	-	1(a) 2(c)	387
Greene	27	10,300	2	1,112	4	1,947	0	-	9	4,532	6	2,225	0	-	1	237	3	144	1(e) 1(a)	103
Indiana	33	13,400	1	-	2	352	1	-	18	5,496	8	4,788	0	-	0	-	0	-	3(c)	2,764
Washington	70	30,600	3	1,600	19	8,048	3	340	19	8,727	19	6,336	2	410	0	-	0	-	4(c) 1(a)	5,141
Westmoreland	88	41,700	5	1,321	10	1,334	3	305	31	22,777	26	7,138	4	1,640	0	-	0	-	2(b) 1(h) 1(k) 2(i) 1(m) 2(c)	7,185
Total	472	244,700	16	10,208	77	18,477	18	2,770	196	95,594	104	43,932	14	9,121	5	3,423	5	1,441	4(a) 1(c) 6(b) 2(g) 15(c) 1(h) 1(d) 2(i) 1(j) 2(k) 1(l) 1(m)	59,734
% of Total	100%	8.5% **	3.4%	4.2%	16.3%	7.6%	3.8%	1.1%	41.5%	39.0%	22%	18%	3%	3.7%	1.1%	1.4%	1.1%	0.6%	7.8%	24.4%

* Advanced treatment is defined as microstraining, sand filtration or stabilization ponds.

** Based on 1970 population of 2,875,000

Footnotes:

- (a) No information
- (b) Trickling filter
- (c) No treatment
- (d) Stabilization pond/sand filtration
- (e) Sand filtration/polishing pond
- (f) Septic tank/trickling filter
- (g) Pre-Aeration
- (h) Trickling filter/sand filtration
- (i) Trickling filter/extended aeration
- (j) Imhoff Tank/extended aeration
- (k) Contact stabilization
- (l) Activated sludge/sand filtration
- (m) Primary settling/sand filtration

receiving rivers in these areas have to assimilate large volumes of discharge. For example, Table 2.1.6.-41 lists the important municipal facilities in COWAMP Area #9 having a discharge greater than one million gallons per day, and names their receiving streams. Table 2.1.7.-42 tabulates total waste flows for large urban areas in COWAMP Study Areas #8 and #9. This table also compares total waste flows to average and 7-day, 10-year low flows of receiving streams. Although Pittsburgh has, by far, the largest waste flow (almost 200 million gallons per day) there is greater potential impact on water quality from several of the smaller urban areas. For example, five urban areas in COWAMP Area #9 have a total waste flow which is about 20% of the average receiving stream flow. These areas are: (2)

- Uniontown area on Redstone Creek
- Washington area on Chartiers Creek
- Greensburg area on Jack's Run
- Jeannette-Irwin area on Brush Creek
- Bethel Park-Pleasant Hills area on Peters Creek

COWAMP Area #8 does not have any urban waste flows greater than 1.4% of the average receiving stream flow so the potential water quality impact is not high from that source. (1)

It is not always large urban discharges that have a high potential for creating wastewater problems. In some cases municipal and non-municipal discharges from smaller areas may cause a greater impact if the receiving stream is small or if wastes are poorly treated. For example, serious problems may occur on small streams by discharge from small extended aeration plants that are poorly maintained or where the ratio of waste flow to stream flow is high. Table 2.1.6.-43 lists the municipal facilities that discharge to small streams and compares the waste flow for each facility with the average flow and 7-day, 10-year low flow for each receiving stream. There are some alarmingly high

TABLE 2.1.6.-41

IMPORTANT MUNICIPAL FACILITIES BY FLOW: COWAMP AREA #9

Source (2)

Facility Name	County	QTP (mgd)	Receiving Stream	Treatment Method
Piney Fork System	Allegheny	2.7	Piney Fork Cr.	Secondary
Coraopolis MSA	Allegheny	2.7	Ohio R.	Primary
Upper Allegheny JSA	Allegheny	4.0	Allegheny R.	Primary
McKeesport WPCA	Allegheny	5.5+	Monongahela R.	Primary
Sandy Creek STP	Allegheny	2.1	Sandy Cr.	Secondary
ALCOSAN Pgh.	Allegheny	190	Ohio River	Secondary
Pleasant Hills MA	Allegheny	2.4	Lick Run	Secondary
Aliquippa STP	Beaver	3.2	Ohio R.	Secondary
Beaver Falls STP(a)	Beaver	2.1	Beaver R.	Primary
Butler Area STP	Butler	4.5	Connoquenessing R.	Secondary
Connellsville STP	Fayette	2.0	Youghiogheny R.	Primary
Uniontown STP	Fayette	4.0	Redstone Cr.	Secondary
Indiana MSS	Indiana	6.0	Two Lick Cr.	Secondary
Canonsburg-Houston STP(a)	Washington	2.9	Chartiers Cr.	Primary
Mon. Valley Auth. STP	Washington	2.9	Monongahela R.	Secondary
Washington STP(a)	Washington	4.5	Chartiers Cr.	Secondary
Kiski Valley WPCA	Westmoreland	2.5	Kiskiminetas R.	Secondary
Greensburg STP	Westmoreland	5.0	Jack's Run	Secondary
Jeanette STP	Westmoreland	2.7	Brush Cr.	Secondary
Latrobe STP(a)	Westmoreland	2.1	Loyalhanna Cr.	Primary
N. Kensington STP	Westmoreland	6.0	Allegheny R.	Primary
W. Westmoreland STP	Westmoreland	11.0	Brush Cr.	Tertiary
Unity Twp. SS	Westmoreland	1.6	Four Mile Run	None

TABLE 2.1.6.-42

WASTE FLOW AND STREAM FLOW FOR MAJOR URBAN AREAS: COWAMP AREA #8

Source (1)

Urban Area	Waste Flow (mgd)	Receiving Stream	Average Flow (cfs)	% Waste Flow of Average Flow	Low Flow (cfs)	% Waste Flow of Low Flow
Meadville		French Creek	1,400[1]		70	
5 Municipal Facilities	3.97					
14 Private Facilities	0.2705					
Total	4.2405			0.47		9.4
Sharon		Shenango River[2]	713		204*	
6 Municipal Facilities	5.56					
13 Private Facilities	0.696					
Total	6.256			1.4		4.7
New Castle		Beaver River[3]	2,335		495	
2 Municipal Facilities	5.07					
18 Private Facilities	0.242					
Total	5.312			0.35		1.7
Warren		Allegheny River[5]	3,758		170*	
2 Municipal Facilities	2.71					
14 Private Facilities	1.0463					
Total	3.7563			0.15		3.4
Oil City - Franklin		Allegheny River[6]	10,250		1,000[4]	
4 Municipal Facilities	4.7					
10 Private Facilities	0.1227					
Total	4.8227			0.073		0.70

Notes:
- * Flow controlled by reservoir
- 1 Estimated from drainage area
- 2 Gaging station at Sharpsville
- 3 Gaging station at Wampum
- 4 Low flow for 1973 water year from USGS records
- 5 Gaging station at Kinzua Dam
- 6 Gaging station at Franklin

Average flow data taken from USGS gaging station data, except where noted.
Low flow estimated from drainage area and low flow areal yields as given in the UDOM data base prepared by Buchart-Horn, Inc., except where noted.

TABLE 2.1.6.-42 (Continued)

WASTE FLOW AND STREAM FLOW FOR MAJOR URBAN AREAS: COWAMP AREA #9

Source (2)

Urban Area	Waste Flow (mgd)	Receiving Stream	Avg.Flow (cfs)	% Waste Flow of Avg.Flow	Low Flow (cfs)	% Waste Flow of Low Flow
Kittanning-Ford City		Allegheny River	15,460	0.03	1,550*	0.27
7 Municipal Facilities	2.630					
6 Non-Municipal Facilities	0.100					
Total	2.730					
Beaver Falls-New Brighton		Beaver River	3,379	0.15	552	0.96
5 Municipal Facilities	3.179					
4 Non-Municipal Facilities	0.043					
Total	3.222					
Aliquippa-Rochester		Ohio River	32,680**	0.05	5,505	0.27
13 Municipal Facilities	9.470					
7 Non-Municipal Facilities	0.212					
Total	9.682					
Butler		Connoquenessing Creek	161**	4.66	40.0	18.77
8 Municipal Facilities	4.816					
1 Non-Municipal Facility	0.038					
Total	4.854					
Uniontown		Redstone Creek	41.8**	24.92	1.2	868
5 Municipal Facilities	6.660					
7 Non-Municipal Facilities	0.073					
Total	6.733					
Connellsville		Youghiogheny River	2,533	0.15	249	1.5
4 Municipal Facilities	2.410					
2 Non-Municipal Facilities	0.017					
Total	2.427					
Indiana		Two Lick Creek	150**	6.21%	12.1	77.0
1 Municipal Facility	6.000					
2 Non-Municipal Facilities	0.021					
Total	6.021					

TABLE 2.1.6.-42 (Continued)

Urban Area	Waste Flow (mgd)	Receiving Stream	Avg.Flow (cfs)	% Waste Flow of Avg.Flow	Low Flow (cfs)	% Waste Flow of Low Flow
Washington		Chartiers Creek	32.7**	22.1	0.69	1,046
5 Municipal Facilities	4.611					
8 Non-Municipal Facilities	0.053					
Total	4.664					
Canonsburg		Chartiers Creek	81.4**	6.42	1.72	304
2 Municipal Facilities	3.370					
2 Non-Municipal Facilities	0.009					
Total	3.379					
Vandergrift		Kiskiminetas River	3,051	0.13	488	0.82
1 Municipal Facility	2.500					
3 Non-Municipal Facilities	0.085					
Total	2.585					
Greensburg		Jack's Run	37.9**	20.7	0.23	3,408
4 Municipal Facilities	5.035					
2 Non-Municipal Facilities	0.031					
Total	5.066					
Jeannette-Irwin		Brush Creek	52.2**	17.2	0.31	2,893
8 Municipal Facilities	5.535					
9 Non-Municipal Facilities	0.262					
Total	5.797					
Latrobe		Loyalhanna Creek	358**	1.85	8.33	79.5
7 Municipal Facilities	4.237					
4 Non-Municipal Facilities	0.043					
Total	4.280					
Monongahela-Donora-Monessen-Charleroi-California		Monongahela River	8,758	0.17	907	1.66
18 Municipal Facilities	9.405					
11 Non-Municipal Facilities	0.303					
Total	9.708					

TABLE 2.1.6.-42 (Continued)

Urban Area	Waste Flow (mgd)	Receiving Stream	Avg.Flow (cfs)	% Waste Flow of Avg.Flow	Low Flow (cfs)	% Waste Flow of Low Flow
Bethel Park-Pleasant Hills		Peters Creek	38.7**	20.5	0.82	968
3 Municipal Facilities	5.130					
No Non-Municipal Facilities	-					
Total	5.130					
McKeesport-Duquesne-West Mifflin		Monongahela River	12,200	0.16	1,197	1.66
11 Municipal Facilities	12.752					
2 Non-Municipal Facilities	0.057					
Total	12.809					
New Kensington-Brackenridge		Allegheny River	19,030	0.10	3,798	0.51
5 Municipal Facilities	12.360					
1 Non-Municipal Facility	0.096					
Total	12.456					
Pittsburgh ***		Ohio River	32,530	0.94	5,500	5.55
26 Municipal Facilities	196.493					
18 Non-Municipal Facilities	0.741					
Total	197.234					

* Low flow in 1973 water year, from USGS gaging station.

** Estimated from drainage area given in UDOM data base and average areal yield in nearest USGS gaging station.

*** The facilities listed are only those which discharge into watershed 20G. This includes ALCOSAN, which treats wastes from most of the Pittsburgh area and has a flow of 190 mgd.

NOTE: Average flows are from USGS gaging stations except where noted otherwise. Low flows are calculated from drainage area and low flow area yields given in the UDOM data base prepared by Buchart-Horn, Inc., except where noted otherwise. Low flows, therefore, do not include flows from municipal treatment plants.

TABLE 2.1.6.-43

MINICIPAL WASTE DISCHARGES TO SMALL STREAMS: COWAMP AREA #8

Source (1)

Borough	Waste Flow (mgd)	Receiving Stream	Average Flow (cfs)	% Waste Flow of Average	Low Flow (cfs)	% Waste Flow of Low Flow
Clarion County						
Knox	0.150	Canoe Creek	20	1.2		
Rimersburg	0.08	Wildcat Run	5	2.5		
Elk County						
St. Mary's	1.5	Elk Creek	20	11.6	3.7	63
Ridgeway	1.5	Elk Creek	110	2.1	9.8	24
Jefferson County						
Sykesville	0.055	Stump Creek	50	0.2		
Lawrence County						
New Wilmington	0.2	L.Neshannock Creek	150	0.2	3	10.3
Mercer County						
Mercer	0.377(a)	Neshannock Creek	180	0.3	5	11.7
Grove City	1.159(b)	Wolf Creek	120	1.5		
McKean County*						
Bradford	4.8	Tunnungwant Creek	250	3.0	16	46
Kane (Kinzua Road)	0.35	Hubert Run	20	2.7		
(West Run)	0.35	West Run	20	2.7		
Mt. Jewett	0.15	Kinzua Creek	74	0.3	5	4.6
Potter County*						
Coudersport	0.62	Allegheny River	170	0.6	4	24
Venango County						
Pleasantville	0.064	Pithole Creek	5	2.0		

* McKean and Potter Counties are not in the ORBES Region

(a) Includes East Lackawannock Township municipal plant and several private facilities. Flow measured at Mercer.

(b) Includes several private facilities.

Low flow data included only where available from the UDOM data base prepared by Buchart-Horn, Inc. Average flow data estimated from drainage area.

TABLE 2.1.6.-43 (Continued)

MUNICIPAL WASTE DISCHARGES TO SMALL STREAMS:

COWAMP AREA #9

Source (2)

Municipality	Waste Flow (mgd)	Receiving Stream	Avg.Flow (cfs)	% Waste Flow of Avg.Flow	Low Flow (cfs)	% Waste Flow of Low Flow
ALLEGHENY COUNTY						
Hampton Twp. (Allison Park STP)	0.5	Pine Creek	58.1	1.33	0.98	79
McCandless Twp. (Longvue #1 STP)	1.1	Little Pine Creek	1.61	106	0.03	5,676
Moon Twp. (Fern Hollow Road STP)	1.7	Montour Run	43.6	6.04	0.73	360
Penn Hills Twp. (Long Road STP)	0.85	Chalfont Run	1.75	75.2	0.01	13,158
Gascola STP	1.3	Thompson Run	5.0	40.2	0.04	5,031
Plum Creek STP	0.85	Plum Creek	24.6*	5.3	0.18*	731
Plum Borough (Holiday Park STP)	0.8	Abers Creek	8.9	13.9	0.07	1,770
BUTLER COUNTY						
Cranberry Twp. (Fenway & Porch Road Plants)	0.659	Brush Creek	14.9*	6.85	0.33*	309
GREEN COUNTY						
Waynesburg	0.78	South Fork Ten Mile Creek	150	0.80	0.137	881
FAYETTE COUNTY						
Georges Twp.	0.716**	Georges Creek	17.4	6.37	0.0	-

TABLE 2.1.6.-43 (Continued)

Municipality	Waste Flow (mgd)	Receiving Stream	Avg.Flow (cfs)	% Waste Flow of Avg.Flow	Low Flow (cfs)	% Waste Flow of Low Flow
WASHINGTON COUNTY						
Peters Twp. (Brush Run STP)	0.8	Brush Run	7.1	17.4	0.19	652
Ellsworth-Bentleyville Area (Pigeon Creek STP)	1.02***	Pigeon Creek	39.4	4.01	1.18	134
WESTMORELAND COUNTY						
Franklin Twp. (Franklin Twp. STP)	1.4	Turtle Creek	60.3	3.59	0.44	493
Ligonier	0.6	Loyalhanna Creek	55.3	1.68	1.98	46.9
Mt. Pleasant	0.91	Shupe Run	4.1	34.4	0.16	880
Scottdale-Everson Area	1.18	Jacobs Creek	79.5	2.30	0.52	351

* **Drainage area estimated from map; low flow areal yields taken from UDOM data base for** Nearest stream.

** Raw Sewage

*** Treatment plant is under construction as of 1975.

NOTE (1): Average flows are calculated from drainage areas given in the UDOM data base prepared by Buchart-Horn, Inc. and areal yields at the nearest USGS gaging station. Low flows are calculated from drainage areas and low flow yields given in the UDOM data base. Neither average nor low flows include the flows from municipal waste treatment plants.

NOTE (2): **Only discharges greater than 0.5 mgd have been listed for Area #9.**

ratios of waste flow relative to the average flow for small streams - one in excess of 100% on Little Pine Creek in Allegheny County. The other high percentages occur on Chalfont Run, Thompson Run, Abers Creek, Brush Run and Shupe Run in COWAMP Area #9 and Elk Creek and Tunungwant Creek in Area #8.

Furthermore, regardless of the flows, there are numerous discharges which are raw or receiving only primary treatment. They are, therefore, in violation of Federal standards and are considered to be degrading the water quality of their receiving streams. Most problems concerning municipal discharges are attributed to these discharges. 46% of municipal facilities in COWAMP Area #9 have raw discharges and 6% have only primary treatment. In COWAMP Area #8 these figures are 11% and 18% respectively (see Table 2.1.6.-39). COWAMP Area #9 report (2) examines this problem on a county-by-county basis, while COWAMP Area #8 report (1) looks at it by watersheds. Extracts from both reports are reproduced below. The water quality network sampling stations cited are defined in Table 2.1.6.-3.

COWAMP AREA #9

> In Allegheny County, WQN sampling stations on the Ohio River (Station 902), the Monongahela River (Station 701), Chartiers Creek (Station 914), and Abers Creek (Station 705) show minimum dissolved oxygen (DO) concentrations below standards. Although some of the problem can be attributed to industrial wastes, municipal wastes are probably the principal source of the oxygen demanding material. Other streams depressed by sewage are Plum Creek, Turtle Creek, Montour Run, and New England Hollow Run (site of the 1.2 mgd West Mifflin sewage treatment plant). Deer Creek, Pine Creek, and Peters Creek have been described as being affected by sewage; but sampling stations on these streams show acceptable DO levels, possibly because samples were collected not more than four times per year. The DO for Peters Creek is surprising in view of the high volume of wastes relative to stream flow.
>
> Armstrong County is bordered by Redbank Creek in the north and the Kiskiminetas River in the south. Both streams have had quality problems resulting from raw discharges. Problems in Redbank come from out of the study area; problems in the Kiskiminetas will be discussed under Westmoreland County. Cowanshannock Creek is depressed in the headwaters by sewage, notably the raw discharge at Rural Valley. The creek recovers downstream and at WQN Station 841 indicates no DO problems.

The Beaver River already carries a significant organic load when it enters Beaver County, and water quality is further depressed by sewage treatment plants in the county; two of the larger plants (Beaver Falls and New Brighton) are providing only primary treatment, although upgrading is in progress at both facilities. With the exception of Station 903 on Raccoon Creek, no other WQN stations in Beaver County indicated DO levels below standards. Numerous small treatment plants on the Raccoon Creek may be the cause of the low DO levels.

Many streams in Butler County are affected by municipal wastewater treatment facilities. Connoquenessing Creek has nutrient problems from the sewage treatment plants in the Butler area. Saw Mill Run, a small tributary of Connoquenessing Creek, is depressed downstream from the Deshon treatment plant. Thorn Creek has problems caused by the Saxonburg facility, which has been proposed for upgrading. Breakneck Creek and Brush Creek have problems at low flow from sewage treatment facilities scattered along the streams. South Branch Bear Creek is severely depressed by raw sewage discharges from Bruin, Petrolia, and Karns City.

Redstone Creek in Fayette County is severely affected by sewage, having average DO levels below standards. Raw sewage discharges in the Uniontown area are responsible for this degradation. Dunlap Creek and Georges Creek both have problems with raw municipal discharges at the headwaters.

In Greene County, the South Fork Tenmile Creek experiences stream degradation from raw sewage. There are occasional problems resulting from the Waynesburg discharge even though secondary treatment is provided because of the wide ratio between average stream flow and low flow. Dunkard Creek and Muddy Run experience problems from municipal discharges receiving only primary treatment.

Indiana County has water quality problems in Two Lick Creek caused by raw discharges in Clymer and Homer City; treatment plants are planned at both locations. Raw discharges from Center Township are having some effect on Black Lick Creek. The Conemaugh River is degraded from municipal wastes. Most of the load comes from outside the study area, but raw discharges in Indiana and Westmoreland Counties add to the problem.

In Washington County there are two large urban areas on Chartiers Creek, and the creek is affected by sewage discharges. Because of the large waste flow relative to stream flow and the use of the stream, tertiary treatment has been ordered for the major municipal plants in both areas. Pigeon Creek also has problems from high waste volumes relative to stream flow. The Monongahela River is experiencing some degradation from raw discharges. Raw discharges also are causing problems on Dutch Fork, Cross Creek, Pike Run, and Peters Creek.

Municipal discharges are scattered throughout Westmoreland County, and many localized problem areas on small streams may not have been identified. The Kiskiminetas River has been depressed by raw discharges in the Vandergrift area; but these problems should be corrected by the new Kiskiminetas Valley sewage treatment plant. Sewickley Creek is in good condition upstream of Jack's Run, but Jack's Run is depressed by sewage, and raw discharges occur on several other tributaries. Jacobs Creek is depressed upstream by sewage but recovers downstream from Scottsdale. Despite problems in tributaries in Westmoreland and Fayette Counties, the Youghiogheny River is not significantly degraded. A WQN station on the Youghiugheny in Westmoreland County (707) did have a minimum DO value below standards. Stations on Sewickley Creek (715) and the Kiskiminetas River (809) also indicated low DO concentrations; stations on the Conemaugh River, Loyalhanna Creek, Allegheny River, Jacobs Creek, and Turtle Creek indicated satisfactory DO levels.

In several cases municipal facilities have been identified as affecting stream quality while data indicate only slight effects on dissolved oxygen; for example, at WQN station (916) just below Canonsburg on Chartiers Creek, all DO values satisfied standards. In these cases impacts are based on levels of the nutrients, nitrogen and phosphorus. Concentrations of these nutrients found in streams draining non-urban, forested watersheds in northern Pennsylvania generally were less that 0.06 mg/l total phosphorus as P, less than 0.15 mg/l ammonia as N, and less than 0.3 mg/l nitrate as N. Of the 50 sampling stations in the study area, 10 had total phosphorus levels less than 0.1 mg/l as P, 25 had ammonia concentrations less than 0.2 mg/l as N, and 5 had nitrate levels less than 0.6 mg/l as N. None of the WQN stations had concentrations of all three parameters below background levels found in northwestern Pennsylvania, and only station 840 had concentrations of both phosphorus and ammonia within the range of background levels found in northwestern Pennsylvania. Actual "background" levels vary depending on the area and other sources of nutrients exist, but municipal wastes are a major contributor to high levels of nutrients in surface waters in the study area. Concentrations of ammonia and total phosphorus at the station on Chartiers Creek below Canonsburg (916), for example, averaged 1.59 mg/l as N and 1.04 mg/l as P. These nutrients may lead to eutrophication under certain conditions... (2)

COWAMP AREA #8

Apart from the Bradford Plant, the only major municipal treatment plants...having a severe impact on the receiving stream are those plants providing primary treatment or discharging raw wastes...Major municipalities served by facilities providing only primary treatment **as of March 1975 are Titusville on Oil Creek (Watershed 16E),** Brookville on Redbank Creek (Watershed 17C), Ellwood City on Connoquenessing Creek (Watershed 20C), and Farrell on the Shenango River (Watershed 20A). Upgrading is in progress at Ellwood City and Farrell. There is a major municipal discharge of raw sewage from Falls Creek Borough on Sandy Lick Creek (Watershed 17C). Treatment plants are planned at Falls Creek and Brookville pending federal funding. Other discharges of raw or primary treated wastes are: in Clarion County, New Bethlehem on Redbank Creek (17C), and Sligo on Licking Creek (17B); in Crawford County, Saegertown on Woodcock Creek (16A) and Bloomfield Township on Canadohta Lake (16E); in Forest County, Tionesta

> on the Allegheny River (16F); in Jefferson County, Snyder Township on Little Toby Creek (17A); in Lawrence County, Ellport on Connoquenessing Creek (20C), Neshannock Township on a tributary of the Shenango River (20A), and Wampum on the Beaver River (20B); in McKean County, East Smethport on Potato Creek (16C); in Mercer County, East Lackawannock on a tributary of Neshannock Creek (20A) and West Middlesex on the Shenango River (20A); in Potter County, Ulysses on the Genessee River (14A); in Venango County, Cooperstown on Sugar Creek (16D) and Emlenton on the Allegheny River (16G). Private facilities discharging untreated wastes are the Carbon Limestone Company in Lawrence County and the Grandview Convalescent Home in Venango County...(1)

B. Industrial Wastewaters

Pittsburgh and its vicinity is the most highly industrialized section of Pennsylvania and is a major steel producing area of the United States. Within COWAMP Study Area #9 there are 550 direct stream industrial dischargers that generate an average wastewater flow of 2,260 million gallons per day. This flow is approximately 9.4% of the average 1973 flow of the Ohio River at Sewickley. COWAMP Area #8 to the north is not a highly industrialized area, so the major potential for water quality impact from industrial waste lies in Allegheny and surrounding counties.

The state requirements governing industrial waste discharge are contained in Chapter 97 of the Department of Environmental Resources "Rules and Regulations" (12). The requirements relating to mineral preparation, oil and natural gas wells, underground disposal and heat pollution from the existing version of Chapter 97 (40) are presented in Table 2.1.6.-44.

Recently, in February, 1978 (3), and March, 1978 (11), there were proposed revisions to delete sections of the Chapter because some jurisdiction will be transferred to Chapter 95 concerning wastewater treatment and will no longer be the domain of industrial waste. Most of the subject matter to be deleted deals with milk processing, the paper industry and organic waste from distilleries and tanneries (3). The section on heat pollution has been rewritten in accord-

TABLE 2.1.6.-44

EXISTING INDUSTRIAL WASTE TREATMENT REQUIREMENTS
Sources (12), (40)

TITLE 25. RULES AND REGULATIONS
PART I. DEPARTMENT OF ENVIRONMENTAL RESOURCES
Subpart C. PROTECTION OF NATURAL RESOURCES
ARTICLE II. WATER RESOURCES

CHAPTER 97. INDUSTRIAL WASTES

Authority

The provisions of this Chapter 97 issued under act of June 22, 1937, P.L. 1987 § 5 (35 P.S. § 691.5).

Source

The provisions of this Chapter 97 adopted

GENERAL PROVISIONS

§ 97.1. Definitions.

The following words & terms, when used in this Chapter, shall have the following meanings, unless the context clearly indicates otherwise:

Daily Average - The arithmetic average of all daily determinations made during a calendar month.

Daily Determination - The arithmetic average of all determinations made during a 24-hour period.

Federal Water Pollution Control Act - The Federal Water Pollution Control Act (33 U.S.D. §§ 1251 et seq.) as amended.

§ 97.2. Degrees of treatment required.

(a) In issuing its orders for abatement or treatment of polluting wastes to the waters of this Commonwealth, the Department shall set forth the degree of treatment required in terms of the treatment of sewage and shall specify that in the case of industrial wastes they shall be given equivalent treatment.

(b) The tests to be applied to such wastes shall be those appropriate to the particular type of waste under consideration, as well as suitable for determining equivalency.

(c) As the equivalency of various industrial wastes is determined periodically by the Department, the information shall be made available to the public in the form of standards for industrial wastes.

STANDARDS

§ 97.11. Special Values.

In order to specify the required reduction in pollution load of wastes

TABLE 2.1.6.-44 (Continued)

from various sources, certain values shall represent the "normal raw waste characteristics" from various manufacturing processes. Except where, in the opinion of the Department, special conditions require some modification of these values, the reduction in pollution load required shall be computed from adopted and applicable standards.

§ 97.12. Effluent characteristic standards.

In some cases the Department shall adopt standards with respect to the characteristics of the effluent discharged to the receiving stream or as to the amount, rate or manner in which the wastes may be discharged. These standards shall be revised when, in the opinion of the Department, changed conditions or increased knowledge warrant the revision.

§ 97.13. Characteristics of waste water.

The characteristics of the waste waters from an industrial establishment to be used in determining compliance with standards established by the Department for "normal" raw wastes and final effluent shall be those due to changes or additions resulting from the use of the water by the industry.

§ 97.14. Measures to be used.

The pollution load of wastes shall be reduced to the maximum extent practical by process changes, segregation of strong wastes, reduction in volume and re-use of water, and by general measures of "good housekeeping" within the plant. The term "practical" shall not be limited to profitable or economical.

§ 97.15. Quality standards.

Industrial wastes regulated by this Chapter shall meet the following quality standards:

(1) There shall be no discharge of wastes which are acid.

(2) Wastes shall have a pH of not less than 6.0 and not greater than 9.0 except that wastes discharged to acid streams may have a pH greater than 9.0

(3) Wastes shall not contain more than 7.0 mg/l of dissolved iron.

(4) When surface waters are used in the industrial plant, the quality of the effluent need not exceed the quality of the raw water supply if the source of supply would normally drain to the point of effluent discharge.

.
.
.

MINERAL PREPARATION

§ 97.31. Coal washeries.

Operators of all coal washeries constructed in this Commonwealth, whether a closed system or not, shall be required to submit an application and plans and secure a permit from the Department prior to placing the facilities in operation.

§ 97.32. Discharges to surface waters.

Wastes discharged to surface waters of this Commonwealth from mineral

TABLE 2.1.6.-44 (Continued)

preparation, handling or processing plants shall meet the following quality standards:

(1) Wastes shall contain no more than 200 mg/l of suspended solids.
(2) There shall be no discharge of acid wastes.
(3) Wastes shall have a pH of not less than 6.0 nore more than 9.0
(4) Wastes shall not contain more than 7.0 mg/l of dissolved iron.
(5) When surface waters are used in the mineral preparation plant, the quality of the effluent need not exceed the quality of the raw water supply if the source of supply would normally drain to the point of effluent discharge.

§ 97.33. Discharges to underground waters.

Wastes discharged to the underground waters of this Commonwealth shall meet one of the following conditions:

(1) The quality standards set forth in § 97.32(2) - (4) of this Title (relating to discharges to surface waters).
(2) That the wastes shall be discharged in accordance with the conditions of a permit issued under the provisions of § § 97.71 - 97.75 of this Title (relating to underground disposal of wastes).
(3) That the wastes shall be discharged into mine workings where the wastes do not adversely affect the quality of the mine drainage.

§ 97.34. Drainage from active mineral refuse.

Drainage from active mineral refuse piles, mineral stockpiles and related facilities, other than seasonal surface run-off caused by precipitation on the refuse and stockpiles, shall meet the quality standards of § 97.32 of this Title (relating to discharges to surface waters).

§ 97.35. Disposal of solids from water-borne wastes.

The disposal of solids removed from water-borne wastes shall be conducted so that the solids are not washed, conveyed or otherwise deposited into the surface waters of this Commonwealth.

⋮

OIL AND NATURAL GAS WELLS

§ 97.51. Sumps.

(a) A sump shall be provided for each well drilling operation.
(b) Each sump shall be large enough to receive without overflow all drill cuttings, water and oil that may be produced in the drillings and cleaning of the well.
(c) Surface water shall be excluded from the sumps by means of diversion ditches on the uphill sides, or by other appropriate measures.
(d) After completion of the well, any oil and basic sediment that has accumulated shall be burned or disposed of in such a manner as to avoid a fire hazard.
(e) Propoer measures shall be taken to prevent sump contents from being washed into streams.

TABLE 2.1.6.-44 (Continued)

§ 97.52. Sump overflow device.

In case abnormally large quantities of water are encountered in drilling, as to exceed the capacity of the sump, the sump shall be provided with a suitable overflow device and the water shall be discharged to the sump at a rate and manner that any overflow from the sump will be free of settleable solids and substantially free of turbidity.

§ 97.53. Sump equivalent.

Where the location of a well precludes or makes unnecessary the use of a sump, equivalent measures shall be taken to prevent the pollution of the waters of this Commonwealth.

§ 97.54. Domes for wells.

(a) If large volumes of oil are encountered in shooting a well, a dome shall be placed over the well or other suitable measures shall be taken to prevent the discharge of any oil to the waters of this Commonwealth.

(b) Oil wastes shall not be dumped or drained upon the surface of the ground in such a manner that they may flow or be washed into the waters of this Commonwealth.

§ 97.55. Waste tanks.

For all producing wells, adequate provision shall be made to receive all salt water, oil and BS in tub tanks or suitable containers from which all such wastes, tank bottoms and other petroleum residues shall be discharged into one or more sumps of adequate size, or into equivalent settling devices, equipped with baffles, siphons or other suitable means to prevent all oil and residues from reaching the waters of this Commonwealth.

§ 97.56. Cleaning operations.

Cleaning tubing or other apparatus connected with the operation of an oil well shall be done in a manner and location that the wastes shall not drain or be washed into a stream, and in such a manner that combustible wastes can and will be burned periodically, using proper precautions to control the fire.

§ 97.57. Receiving tanks.

(a) All run tanks, separators or siphon tanks shall be so located that salt water, oil, BS or other wastes will be discharged into one or more sumps of adequate size to receive and settle the wastes, and so located as not to be washed out by stream flows. Any water from such sumps shall be discharged through a siphon or other suitable device so installed as to prevent any oil or petroleum residues from reaching the waters of this Commonwealth.

(b) Oil and petroleum residues shall be periodically burned using proper precautions to control the fire.

§ 97.58. Water filter backwash.

(a) The backwash from the operation of water filters shall be settled in sumps or equivalent devices adequate to provide at least an eight-hour retention

TABLE 2.1.6.-44 (Continued)

period, and so arranged as to provide quiescent sedimentation and the discharge **of the clar**ified effluent free from settleable solids and substantially free from turbidity.

(b) The sludge from any sedimentation basins which precede the filter units shall be removed periodically and disposed of in such a manner so as not to be drained or washed into the waters of this Commonwealth.

OTHER WASTES

§ 97.61. Wells other than oil or gas.

(a) At each well drilling operation there shall be provided a sump or other receptacle large enough to receive all drill cuttings, sand bailings, water having a turbidity in excess of 1,000 ppm, or other polluting wastes resulting from the well drilling operations.

(b) Surface water shall be excluded from the sump or receptacle by means of diversion ditches on the uphill sides, or by other appropriate measures.

(c) After completion of the well the sump shall be covered over or otherwise protected or the contents of the receptacle disposed of, so that the contents will not be washed into the waters of this Commonwealth.

(d) Any waste oil, coal, spent minerals or other polluting substances shall be so disposed of that they will not be washed into the waters of this Commonwealth.

§ 97.62. Reserved.

§ 97.63. Oil Bearing Waste Waters.

(a) For the purpose of this section, the quantity of oil shall be measured by the freon extraction gravimetric method of oil analysis (Standard Methods for the Examination of Water and Wastewater - Method 502A; 14th Edition, published by the American Public Health Association, America Waterworks Association and the Water Pollution Control Federation, 1015 18th Street N.W., Washington, D.C. 20036).

(b) Wastewaters, except those from petroleum marketing terminals, discharged into the waters of this Commonwealth shall comply with all of the following:

(1) At no time cause a film or sheen upon or discoloration of the waters of this Commonwealth or adjoining shoreline; and

(2) At no time contain more than 15 milligrams of oil per liter as a daily average value nor more than 30 milligrams of oil per liter at any time, or whatever lesser amount the Department may specify for a given discharge or type of discharge as being necessary for the proper protection of the public interest or to meet any requirements based upon the Federal Water Pollution Control Act.

(c) Petroleum marketing terminals shall be provided with facilities to remove oil from waters, including stormwater runoff, before discharge into the waters of this Commonwealth. Compliance with this subsection shall constitute compliance with subsection (b) of this section except to the extent that the Federal Water Pollution Control Act imposes a more stringent requirement. Pollution Incident Prevention Plans as described in Section 101.3 of this title (relating to activities utilizing polluting substances), are required for all petroleum marketing terminals.

(d) Unless it can be shown that an alternate design is equivalent, oil removal facilities of petroleum marketing terminals shall consist of an American

TABLE 2.1.6.-44 (Continued)

Petroleum Institute (A.P.I.) oil separator designed and operated in accordance with the following standards:

(1) The horizontal velocity through the separator shall not exceed three feet per minute except when rainfall produces a runoff exceeding 80 gallons per minute per acre of land draining to the separator. When such runoff occurs there will be no limit on the horizontal velocity.

(2) The detention time of water flowing through the separator shall be at least 20 minutes except when rainfall produces a runoff exceeding 80 gallons per minute per acre of land draining to the separator. When such a rainfall occurs the detention time may be less than 20 minutes.

(3) The separator shall be capable of treating 80 gallons per minute for each acre of land draining to it during the runoff period.

(4) Solids build up in the separator shall be measured after each rainfall, and when the build up exceeds one foot in depth from the bottom, the solids shall be removed before the next rainfall.

(5) The separator shall be inspected after each rainfall to insure that the oil is being properly removed. Excessive oil shall not be allowed to accumulate in the separator.

(6) Oil and solids, removed from the separator shall be disposed of in a manner that will not violate the laws of the Commonwealth.

(7) A record showing the dates when solids and oil are removed from the separator and the location of the disposal site shall be kept and maintained for a period of one year.

(e) Where the standard design in subsection (d) of this section or an equivalent alternate design are followed, no permit for the discharge of oil from petroleum marketing facilities to the waters of this Commonwealth shall be required pursuant to Section 307 of the act of June 22, 1937, P.L.1987, as amended (35 P.S. § 691.307).

§ 97.64. Distillery wastes.

Distillery waste waters shall be completely evaporated or shall be given enough equivalent treatment before discharge to the waters of this Commonwealth to remove not less than 95% of the five-day BOD of the wastes.

§ 97.65. Tannery waste waters.

(a) The process for the treatment of waste waters resulting from the vegetable tanning of leather, as set forth in the report of the Tannery Waste Disposal Committee of Pennsylvania to the Sanitary Water Board, dated November 8, 1930, shall be considered by the Department to be reasonable and practicable.

(b) Tannery waste waters shall be treated by one or more of the steps set forth in such report, as may be required by the Department for particular streams or locations.

§ 97.66. Reserved.

UNDERGROUND DISPOSAL

§ 97.71. Potential pollution.

The Department shall, except as otherwise provided in this section consider the disposal of wastes, including storm water runoff, into the underground as

TABLE 2.1.6.-44 (Continued)

potential pollution unless the disposal is close enough to the surface so that the wastes will be absorbed in the soil mantle and be acted upon by the bacteria naturally present in the mantle before reaching the underground or surface waters.

§ 97.72. Discharge into mines.

Discharge of inadequately treated wastes, except coal fines, into the underground workings of active or abandoned mines shall be prohibited.

§ 97.73. Discharge into wells.

Discharge of wastes into abandoned wells shall be prohibited.

§ 97.74. Disposal in underground horizons.

(a) Disposal of wastes into underground horizons shall only be accepted as an abatement of pollution when the applicant can show by the log of the strata penetrated and by the stratigraphic structure of the region that it is improbable that the disposal would be prejudicial to the public interest. Acceptances shall be conditional and shall not relieve the applicant of responsibility for any pollution of the waters of this Commonwealth which may occur.

(b) If any pollution occurs the disposal operations shall be stopped immediately.

§ 97.75. New wells for waste disposal.

New wells constructed for waste disposal shall be subject to the provisions of § § 97.71 - 97.74 of this Title (relating to underground disposal of wastes).

HEAT POLLUTION

§ 97.81. Prohibition.

The temperature of the waters of this Commonwealth shall not be increased artificially in amounts which shall be inimical or injurious to the public health or to animal or aquatic life or prevent the use of water for domestic, industrial or recreational purposes, or stimulate the production of aquatic plants or animals to the point where they interfere with these uses.

§ 97.82. Allowable discharges.

(a) The heat content of discharges shall be limited to an amount which could not raise the temperature of the entire stream at the point of discharge 5°F. above ambient temperature or a maximum of 87°F., whichever is less, nor change the temperature by more than 2°F. during any one-hour period, assuming complete mixing but the heat content of discharges may be increased or further limited where local conditions would be benefited thereby.

(b) Where downstream circumstances warrant, the specific area in which the temperature may be artificially raised above 87°F. or greater than 5°F. above ambient temperature or by more than 2°F. during any one-hour period shall be prescribed.

§ 97.83. Fishways.

A fishway shall be required in streams receiving heated discharges where it is essential for the preservation of migratory pathways of game fish, or

TABLE 2.1.6.-44 (Continued)

for the preservation of important aquatic life. The dimensions of the fishway shall be prescribed in each case, dependent upon the physical characteristics of individual streams whenever necessary.

§ 97.84. Acid-impregnated streams.

Sections 97.82 and 97.83 of this Title (relating to heat and discharges into streams) shall not apply to streams so impregnated with acidic mine drainage that they cannot support a fish population typical of the region.

§ 97.85. Trout Streams.

There shall be no new discharge to waters providing a suitable environment for trout if as a result the temperature of the receiving stream would be by more than 5°F. above natural temperatures or be increased above 58°F.

§ 97.86. Estuarial waters.

(a) Reduction of heat content of discharges to estuarial waters shall be required where necessary to protect the public interest.

(b) Estuarial waters shall not be considered all those containing ocean salts. Tidal waters not containing ocean salts are considered as fresh water streams.

ance with the recently proposed Chapter 93 which sets water quality standards in general (11). Part of this section (dealing with aquatic life and estuary waters) will be deleted to clarify the division of responsibility between the three chapters. These proposed revisions are detailed in Table 2.1.6.-45.

There are 721 industrial direct stream discharges in COWAMP Study Areas 8 and 9. These are inventoried in Chapter VII, Appendix A of both the Area #8 and Area #9 COWAMP Reports (1), (2). Maps showing the location of facilities and discharges are available in the Plates in the COWAMP Reports for Areas #8, #9, #5, and #6. (1), (2), (3), and (4). The inventories list the following for each plant, county by county: name and owner, DER-WAMIS identification number, location (municipality and COWAMP Sub-basin), Standard Industrial Classification (SIC) Code, number of employees, total (both design and actual) wastewater flow, number of outfalls, treatment provided, receiving stream (name, condition, and classification), priority of discharge (based on a system of rating which considers potential water quality impact and flow rate of effluent), and estimates of area available for expansion of the facility. More specific and detailed information on each industrial plant and the wastewater discharges are given in subsequent tables of the COWAMP Reports for the 248 "major" industries--those with serious potential water quality impact and/or large wastewater flow rate.

A relatively small number of major industrial dischargers account for a large portion of the total industrial wastewater flow. For example, in Study Area #9, the 17 largest dischargers (3.0% of all industries, by number) account for over 93% of the total study area industrial wastewater flow.

A summary of areas with high concentrations of industrial facilities is given in Table 2.1.6.-46. The number of industrial facilities in the geographic area, the name of those with most severe impact, the total waste flow, and

TABLE 2.1.6.-45

PROPOSED REVISIONS TO INDUSTRIAL WASTE TREATMENT REQUIREMENTS AS OF MARCH 1978

Sources (3), (11)

Deletion of Sections February 4, 1978:

§ 97.2,
§ 97.11 - 97.13,
§ 97.21 - 97.25,
§ 97.41 - 97.45,
§ 97.64 - 97.66.

HEAT POLLUTION

§ 97.82. [~~Allowable discharges~~] Relation to Federal actions.

[~~(a) The heat content of discharges shall be limited to an amount which could not raise the temperature of the entire stream at the point of discharge 5°F. above ambient temperature or a maximum of 87°F. during any one-hour period, assuming complete mixing but the heat content of discharges may be increased or further limited where local conditions would be benefitted thereby.~~

[~~(b) Where downstream circumstances warrant, the specific area in which the temperature may be artificially raised above 87°F. or greater than 5°F. above ambient temperature or by more than 2°F. during any one-hour period shall be prescribed.~~]

Subject to the provisions of § 97.83 of this title (relating to allowable discharges), effluent limitations upon the discharge of heated wastewaters to waters of this Commonwealth shall be established so as to attain and maintain the specific thermal water quality criteria of Chapter 93 of this title (relating to water quality standards) and the requirements of § 97.81 of this title (relating to prohibition); provided that, for the purpose of establishing thermal effluent limitations in a certification issued pursuant to section 401 of the Federal Water Pollution Control Act, 33 U.S.C.A. § 1341, or (35 P. S. §§ 691.1-691.1001) a permit issued pursuant to the provisions of The Clean Streams Law, the Department may rely upon a determination of the United States Environmental Protection Agency or a state, if appropriate, pursuant to Section 316(a) of the Federal Water Pollution Control Act and the regulations promulgated at 40 C.F.R. Part 122 (1977) if such determination was made as a result of a proceeding in which the Department was afforded a full opportunity to participate as a part and if such determination is final, including any judicial proceedings for direct review thereof; provided that, in any event, the Department may impose more stringent thermal limitations to protect the protected uses set forth in § 93.3 of this title (relating to protected water uses).

§ 97.83. [~~Fishways~~] Allowable discharges.

[~~A fishway shall be required in streams receiving heated discharges where it is essential for the preservation of migratory pathways of game fish, or for the preservation of important aquatic life. The dimensions of the fishway shall be prescribed in each case, dependent upon the physical characteristics of individual streams whenever necessary.~~]

(a) The Department may, in its discretion, grant exceptions to the requirement that all heated waste discharges be limited so as to maintain and attain the specific thermal water quality criteria of Chapter 93 of this title (relating to water quality standards) and § 97.81 of this title (relating to prohibition), provided that all of the following conditions are met:

(1) The discharger has demonstrated that the discharge is to receiving waters which are so impregnated with acidic drainage from inactive or abandoned coal mines that those waters cannot support a balanced community of aquatic life as defined in § 93.1 of this title (relating to definitions).

(2) There are neither current nor scheduled abatement programs nor enforcement actions directed toward restoration of the receiving waters.

(3) The discharger agrees, in writing, to upgrade the quality of the discharge so as to attain and maintain the specific thermal water quality criteria of Chapter 93 of this title (relating to water quality standards) and the requirements of § 97.81 of this title (relating to prohibition) when either of the following prevails:

(i) a current or scheduled abatement program is implemented or enforcement action is taken toward restoration of the receiving waters.

(ii) The receiving waters are significantly restored by natural or other means.

(4) The discharger agrees, in writing, to conduct a periodic chemical and biological monitoring program in the receiving waters.

(b) In any event, effluent limitations established for the discharge of heated wastewaters shall be sufficient to comply with any applicable requirements of Federal law.

§ 97.84. [~~Acid-impregnated streams.~~] (Reserved)

[~~Sections 97.82 and 97.83 of this Title (relating to heat and discharges into streams) shall not apply to streams so impregnated with acidic mine drainage that they cannot support a fish population typical of the region.~~]

§ 97.85. [~~Trout streams.~~] (Reserved)

[~~There shall be no new discharge to waters providing a suitable environment for trout if, as a result, the temperature of the receiving stream would be by more than 5°F. above natural temperatures or be increased about 58°F.~~]

§ 97.86. [~~Estuarial waters.~~] (Reserved)

[~~(a) Reduction of heat content of discharges to estuarial waters shall be required where necessary to protect the public interest.~~]

[~~(b) Estuarial waters shall not be considered all those containing ocean salts. Tidal waters not containing ocean salts are considered as fresh water streams.~~]

TABLE 2.1.6.-46

AREAS WITH HIGH CONCENTRATIONS OF INDUSTRIAL DISCHARGES: COWAMP AREA #9

Source (2)

Area	COWAMP Sub-Basin	Total No. Industrial Facilities	Facilities with Severe Impact	Total Industrial Flow (mgd)	Receiving Stream	Receiving Stream Flow Average (cfs)	Receiving Stream Flow 7 day,10 yr. (cfs)
Clairton-Pittsburgh	19A, 19C	43	Penna. Ind. Chem. Corp/ Hercules Inc. Clairton Works/ U.S. Steel Corp. Irvin Plant/ U.S. Steel Corp. National Plant/ U.S. Steel Corp. Duquesne Plant/ U.S. Steel Corp. Edgar-Thompson Plant/ U.S. Steel Corp. Westinghouse Elec. Corp. Carrie Furnace Plant/ U.S. Steel Corp. Homestead Plant/ U.S. Steel Corp. Pittsburgh Works/ Jones & Laughlin Steel	1,243	Monongahela River	12,200	1,197
New Kensington-Pittsburgh	18A	50	Allegheny Ludlum Steel Corp. PPG Glass Research Center Alcoa Research Lab	116	Allegheny River	19,030	3,798
Pittsburgh-Leetsdale	20G	28	Russell Burdsal & Ward Vulcan Detinning/ Vulcan Materials Co. Shenango, Inc. Mayco Co. & Chemical Co. USS Chemicals/ U.S. Steel Corp.	41	Ohio River	32,530	5,500
Bridgeville-Carnegie	20F	15	Specialty Steel Div./ Universal Cyclops Corp. St. Regis Paper Teledyne Col. Summerhill	4	Chartiers Creek	384*	6.21

TABLE 2.1.6.-46 (Continued)

Area	COWAMP Sub-Basin	Total No. Industrial Facilities	Facilities with Severe Impact	Total Industrial Flow (mgd)	Receiving Stream	Receiving Stream Flow	
						Average (cfs)	7 day,10 yr. (cfs)
Kittanning-Ford City	17E	9	Ford City Works/ PPG Industries, Inc. Linde Division/ Union Carbide Corp.	74	Allegheny River	15,460	1,550
Vandergrift	18B	11	Parks Twp. Plant/ Nuclear Mat. & Equi. Co. Altmire Coal Apollo Plant/ Nuclear Mat.& Equip. Co. Vandergrift Plant/ U.S. Steel Corp. West Leechburg Plant/ Ally. Ludlum Steel, Inc.	7	Kiskiminetas River	3,051	488
Aliquippa-Rochester	20G	20	Aliquippa Works/ Jones & Laughlin Steel Armco Steel Corp. Wyckoff-Steel Div./ Ampco Pittsburgh Corp. Valvoline Oil/Ashland Oil & Refining Co. Pittsburgh Tube Co. Colonial Steel Div./ Vasco Teledyne Zinc Smelting Div./ St. Joe Minerals	424	Ohio River	32,680**	5,505
Beaver Falls-Beaver	20B	16	Tubular Prod. Div./ Babcock & Wilcox Co.	10	Beaver River	3,379	522
Butler	20C	11	Butler Works/ Armco Steel Corp.	6	Connoquenessing River	161**	40
Washington	20F	12	Jessop Steel Co./ Athalone Corp. Washington Steel Co.	3	Chartiers Creek	32.7*	0.69

TABLE 2.1.6.-46 (Continued)

Area	COWAMP Sub-Basin	Total No. Industrial Facilities	Facilities with Severe Impact	Total Industrial Flow (mgd)	Receiving Stream	Receiving Stream Flow	
						Average (cfs)	7 day,10 yr. (cfs)
Monongahela-California	19C	20	Allenport Plant/ Wheeling-Pgh. Steel Co. Page Fence Divsion/ American Chain & Cable Monessen Works/ Wheeling-Pgh. Steel Co. Newal Plant/ Allied Chemical Corp.	103	Monongahela River	8,758	907

* Calendar year 1972.

** Estimated drainage and flow at Sewickley gaging station.

details of the receiving stream are listed.

The industrial direct stream discharges are summarized by Major SIC groups in Table 2.1.6.-47 for Study Area #9 and in Table 2.1.6.-48 for Study Area #8. The industry type, its Major SIC Group number, a potential water quality impact rating assigned to the group, and the total wastewater flow is given in the tables.

The total industrial direct discharge in the two COWAMP Study Areas is 244.8 mgd. By far the largest source is the primary metals industry (SIC Major Group 33) with a total flow of 2077 mgd, which comprises approximately 84.9% of the total industrial discharge. Second largest is the chemicals and allied products industry (SIC Major Group 28) with 201 mgd discharge comprising 8.2% of the total.

An account of industrial discharges by county was written in the COWAMP Reports (2) and (1), and this is reproduced below for Area #9 and #8 counties in the ORBES Region.

COWAMP AREA #9

> Allegheny County has the largest concentrations of industrial discharges in the study area. Over 150 industrial facilities discharge wastewaters directly into streams in the county. (Another 250 major industries discharge wastewaters into ALCOSAN) ...Over half the industrial discharges are along the Allegheny, Monongahela, and Ohio Rivers. There are also a number along Chartiers Creek; the remainder are scattered throughout the county.
>
> Along the Monongahela River, total industrial discharges are almost 2000 cfs, about one-sixth of the river's average flow and more than half the industrial flow in the study area. Most discharges emanate from steel plants. Industrial discharges to the Allegheny and Ohio Rivers in Allegheny County are large but do not compare with discharges to the Monongahela in terms of waste flows (see Table 2.1.6.-46). Nevertheless, some industries present hazards to water quality because of the characteristics

TABLE 2.1.6.-47

INDUSTRIAL DIRECT STREAM DISCHARGE SUMMARY BY MAJOR SIC GROUPS - COWAMP AREA #9

Source (2)

Major SIC Group	Rating*	Industry	Number	Total Flow (mgd)	% Total S.A. Flow
01-02	C	Agriculture	4	0.005	0.1
12	A	Coal Processing	56	16.3	0.7
13	C	Natural Gas	1	0.013	0.1
14	C	Mineral Processing	22	3.3	0.1
15-17	C	Construction	10	0.00	0.1
20	A	Food Products	61	5.2	0.2
22	C	Textiles	1	0.010	0.1
24	C	Lumber and Wood	4	0.006	0.1
26	A	Paper Products	6	0.15	0.1
28	A	Chemicals and Allied Products	44	193.	8.6
29	A	Petroleum Refining	30	5.2	0.2
30	B	Rubber and Misc. Products	7	5.4	0.2
31	B	Leather Products	1	0.014	0.1
32	C	Stone, Clay, Glass, Concrete	61	14.4	0.6
33	A	Primary Metals	76	1971.	87.2
34	B	Fabricated Metals	52	15.9	0.7
35	B	Machinery-Nonelectric	12	5.3	0.2
36	B	Machinery-Electric	18	8.14	0.4
37	C	Transportation Equipment	4	0.56	0.1
38	C	Instruments	6	0.17	0.1
40	C	Railroad Services	16	0.23	0.1
42	C	Motor Freight Services	5	0.007	0.1
44	C	Water Transportation Services	1	0.001	0.1
45	B	Air Transportation Services	2	0.058	0.1
46	C	Pipe Lines	3	0.300	0.1
49	C	Utilities	4	0.246	0.1
50	B	Wholesale Trade	3	0.109	0.1
51	C	Petroleum Bulk Stations	11	0.934	0.1
65	C	Commercial Buildings	1	13.5	0.6
72	A	Laundries	4	0.055	0.1
73	A	Laboratories	7	0.683	0.1
75	B	Automotive Services	17	0.065	0.1
		TOTALS	550	2260.	100.0

*Rating was assigned to each SIC Group based on the potential water quality impact of major pollutants associated with the type of industry in the group.

A - Serious potential water quality impact
B - Moderate potential water quality impact
C - Slight potential water quality impact

TABLE 2.1.6.-48

INDUSTRIAL DIRECT STREAM DISCHARGE SUMMARY BY MAJOR SIC GROUPS - COWAMP AREA #8

Source (1)

Major SIC Group	Rating*	Industry	Number	Total Flow (mgd)	% Total Study Area Industrial Flow
09	C	Fish Hatcheries	3	8.56	4.5
12	A	Coal Processing	10	0.73	0.4
14	C	Non-Metalic Mineral Proc.	24	15.11	8.0
20	A	Food Products	8	0.15	0.1
24	C	Lumber and Wood	1	0.02	0.1
25	C	Furniture	1	0.0	
26	A	Paper Products	1	13.05	6.9
28	A	Chemicals and Allied Products	8	8.01	4.2
29	A	Petroleum Refining	9	25.14	13.3
30	B	Rubber and Misc. Products	6	2.14	1.1
31	B	Leather Products	1	0.03	0.1
32	C	Stone, Clay, Glass, Concrete	19	4.00	2.1
33	A	Primary Metals	24	106.47	56.5
34	B	Fabricated Metals	15	1.44	0.8
35	B	Non-Electric Machinery	17	0.34	0.2
36	B	Electric Machinery	11	1.30	0.7
37	C	Transportation Equipment	9	1.67	0.9
38	C	Instruments	1	0.03	0.1
39	C	Misc. Manufacturing	1	0.16	0.1
40	B	Railroad Services	3	0.02	0.1
42	C	Motor Freight	2	0.002	0.1
49	C	Utilities	2	0.002	0.1
72	A	Laundries	3	0.02	0.1
75	B	Automotive Services	2	0.001	0.1
		TOTALS	171	188.40	100.0

*Rating was assigned to each SIC Group based on the potential water quality impact of major pollutants associated with the type of industry in the group.

A - Serious potential water quality impact
B - Moderate potential water quality impact
C - Slight potential water quality impact

of the discharges. Discharges to Chartiers Creek are not particularly large in terms of flow, but represent a significant fraction of the low flow in the creek. Industrial discharges to small streams in the area present problems only during low flow events.

Four power generating facilities in the county use once-through waste heat cooling...Two facilities on the Allegheny River discharge 620 mgd (approximately 3.1 billion BTU's/hr.); there is a 507 mgd discharge to the Monongahela (BTU not given) and a 231 mgd discharge to the Ohio (approximately 1.7 BTU's/hr.). Industrial cooling water adds to the temperature effect from power generating facility discharges; but the additional heat is not significant in relation to the output from the generating facilities except in the Monongahela, where over half the industrial discharge is some form of cooling water.

Of the major rivers, the Monongahela experiences the most problems from industrial wastes with excessive loads of phenols, iron, oil, suspended solids, and occasional problems from thermal discharges. In December 1974, hundreds of complaints were made about bad drinking water in the South Hills area of Pittsburgh. The problem was caused by high levels of phenols in the Western Pennsylvania Water Company water supply, which is drawn from the Monongahela. The high phenol concentrations were attributed to U. S. Steel and Pennsylvania Industrial Chemical Corporation discharges. The Allegheny River has fewer water quality problems from industrial wastes, but has experienced fish kills from industrial operations. The Ohio River, affected by the pollutant load carried by its tributaries and by industrial plants on the main stem, has high phenol levels. Of the smaller streams in the area, Chartiers Creek and Pine Creek have problems caused by industrial wastes; although Pine Creek has only a few industrial discharges, their volume and waste load is large relative to the small flow in the stream. In addition to the above streams, fish kills attributed to industrial sources have occurred on Bull and Blockhouse Creeks.

Industrial discharges in Armstrong County are centered in two areas, the Kittanning-Ford City area on the Allegheny and the Vandergrift area on the Kiskiminetas River. The latter area is discussed under Westmoreland County. Only a few other discharges are scattered throughout the rest of the county; of these, only coal washeries...have a significant impact on stream quality. The one major industrial discharge to a municipal facility causes no problems. In the Kittanning-Ford City area, 9 industries discharge 73.653 mgd to the Allegheny River, with the Linde Division of Union Carbide contributing 72 mgd. Armstrong Electric

Generating Station at Reasedale on the Allegheny discharges 196 mgd of waste heat cooling water (approximately 1.8 billion BTU's/hr.).

Discharges into the Allegheny probably add to the gradual deterioration in water quality of the river as it flows southward, but the Allegheny remains in good condition above its confluence with the Kiskiminetas.

Beaver County has heavy concentrations of industrial discharges along the Ohio and Beaver Rivers, but few other industrial facilities. In the Beaver Falls-Beaver area, 16 industries discharge about 10 mgd into the Beaver River. Twenty industries discharge more than 400 mgd to the Ohio River in the Aliquippa-Rochester area. Two other large discharges are the 105 mgd Arco Polymer discharge to Raccoon Creek at its confluence with the Ohio and the 8 mgd wastewater flow from the Tubular Products Division of Babcock and Wilcox Company into the Beaver River above Beaver Falls. A nuclear power generating facility at Shippingport discharges 165 mgd of cooling water to the Ohio (approximately 0.53 billion BTU's/hr.).

The Beaver River already is polluted when it enters Beaver County; the industrial discharges in Beaver County add to the pollutant load but are not the major cause of its relatively poor water quality. The discharges to the Ohio are large even in relation to the flow in the Ohio and, combined with the pollutant load carried by the Beaver, cause excessive concentrations of heavy metals, cyanide, and phenols in the Ohio. Connoquenessing Creek shows pollution from industrial waste sources outside Beaver County.

Butler County does not have the high concentrations of industrial waste discharges found in other counties, but does have water quality problems from industrial wastes because receiving streams for major discharges are rather small. The Butler area has the largest concentrations of industrial discharges, with about 6.4 mgd flowing into Connoquenessing Creek, which has an average flow of only slightly over 100 mgd. There are a number of industrial discharges scattered along Glade Run, Breakneck Creek, Slippery Rock Creek, and the South Bear Creek. There are additional discharges on the Connoquenessing in the Zelienople area.

The Connequenessing has relatively severe water quality problems resulting from industrial wastes, largely from Armco Steel in Butler, although the other discharges contribute to the problem. Glade Run has high heavy metal concentrations but is in good shape biologically. Breakneck Creek experiences periodic problems with industrial spills. The south branch of Bear Creek is severely depressed by refinery wastes. Fish kills have occurred in all of the above streams, and one kill in Slippery Rock was attributed to an industrial discharge.

Fayette County is not heavily industrialized, having a number of industries in a broad area between Uniontown and Connellsville and several more scattered along the Monongahela River and Jacobs Creek. The major industrial dischargers are Allied Chemical in Newell on the

Monongahela and Anchor Hocking in South Connellsville on the Youghiogheny. The Newell plant - 7.92 mgd - is considered as part of the Monongahela-California area and is discussed under Washington County. The Anchor Hocking plant flow, 0.81 mgd, is small in comparison to the 2500 cfs flow in Youghiogheny; consequently, smaller discharges on Jacobs Creek and the small creeks in the Uniontown-California area have more impact. One such plant is Joseph Packing, which has a high BOD effluent discharged to Opossum Run about one mile above its confluence withe the Youghiogheny. Several small plants discharge to Redstone Creek and its tributaries, and there are a relatively large number of industrial discharges to municipal treatment plants in the Uniontown area; many of these municipal facilities provide less than secondary treatment.

Redstone Creek has significant problems from industrial wastes, particularly phenol and heavy metals. The Youghiogheny River is in good condition but does have high concentrations of aluminum and occasional high phenol levels. Jacobs Creek has high levels of zinc, but discharges in Westmoreland County probably are more responsible than the few in Fayette County.

Greene County, the least industrialized county in the study area, has only 10 industrial discharges directly into the streams and only 1 discharge to a municipal treatment facility. The discharges are not concentrated in any one area but are scattered along the Monongahela River and Tenmile Creek. The only major discharge is a coal washery, discussed in the mineral extraction section. An electric generating station on the Monongahela River opposite Masontown discharges 732 mgd of waste heat cooling water to the Monongahela (approximately 4.5 billion BTU's/hr.).

South Fork Tenmile Creek, because of its small size, does have some problems with industrial wastes even though there are only a few small discharges. Dunkard Creek is depressed due to industrial wastes near its mouth; the sampling station on Dunkard Creek shows high levels of nickel in addition to other constituents normally associated with acid mine drainage, but no industrial discharges on the lower reaches of Dunkard Creek are listed in the NPDES permit files. The Monongahela River is affected by industrial pollution, but major sources are in West Virginia; it is not until the Monongahela-California area that heavy industrial discharges occur.

Indiana County is lightly industrialized, with several industries concentrated in the Indiana - Homer City area on Two Lick and Yellow Creeks and the other discharges scattered throughout the county. The most significant discharge is that of the McCreary Tire Company, with a flow of 3.91 mgd to White Run, a tributary of Two Lick Creek. Several other discharges to Two Lick Creek and its tributaries in the Clymer area make this stream the most heavily affected by industrial discharges originating in Indiana County. The Conemaugh River is depressed by industrial wastes, but most of the impact comes from outside the study area.

Washington County has industrial discharges scattered throughout the area; the greatest concentrations occur in the Washington area, Canonsburg area, and Monongahela-California area on the Monongahela River. The first and last areas are included in Table 2.1.6.-46. The Monongahela area is more notable in terms of industrial flow - over 100 mgd - but in the Washington area there is a greater impact on water quality because the receiving stream, Chartiers Creek, is rather small in that area. Discharges to Chartiers Creek in the Canonsburg area add to the problem. Almost all industrial connections to municipal facilities are also in the above three areas. Industrial discharges outside the three areas are small except for a coal washery on Pigeon Creek. An electric generating facility on the Monongahela at Courtney discharges 453 mgd of cooling water (approximately 2.4 billion BTU's/hr.).

Chartiers Creek has very poor water quality, largely due to acid mine drainage and municipal discharges. Industrial discharges add to the pollutant load. Discharges to the Monongahela River in Washington County are significant because the river has little time to recover before encountering the heavy concentration industrial discharges to Allegheny County.

Westmoreland County is second to Allegheny County in number of industrial discharges, but ranks below Beaver in total flow. The large number of discharges to small streams creates several potential problem areas. Concentrations of industries occur in the Monessen area (part of the Monongahela-California area); in the Vandergrift area on the Kiskiminetas River, where 11 industries discharge 7.4 mgd; in the Greensburg area on Jack's Run, where the industrial flow is 2.2 mgd; in the Jeannette area on Brush Creek, where the industrial flow is 2 mgd; and in the Latrobe area on Loyalhanna Creek, where a total of slightly less than 0.9 mgd is discharged from 9 industrial facilities. Five of the industries in the Vandergrift area and 2 industries in the Latrobe area (see Table 2.1.6.-46) are considered to have potentially severe impacts on water quality. A power generating facility on the Conemaugh River at Hooverville discharges 260 mgd of cooling water (approximately 1.28 billion BTU's/hr.). Other discharges are scattered throughout the county, with numerous discharges in the southwestern portion of the county along Sewickley and Jacobs Creeks and their tributaries. The eastern part of the county is relatively free of industrial discharges.

As previously mentioned, the Conemaugh River already is polluted when it enters the study area. Except for thermal problems from the power generating station, little additional pollution is added to the Conemaugh before its confluence with Loyalhanna Creek to form the Kiskiminetas River. Loyalhanna Creek, however, is affected by industrial wastes, although it has recovered substantially by the time it joins the Conemaugh. Industries in the Vandergrift area make a significant contribution to the pollutant load carried by the Kiskiminetas. Jacobs Creek is in relatively good condition. Sewickley Creek is severely affected by acid mine drainage so that the impact from industrial wastes is difficult to determine. There is little information on Jack's Run and Brush Creek, but the large size of the discharges relative to the small creek flows indicates that careful control of waste discharges in the Greensburg and

Jeannette areas must be exercised to prevent degrading water quality of the streams.

COWAMP AREA #8

There are only a few industrial discharges scattered throughout Clarion County. Of the major discharges, the Glass Container Corporation's cooling water discharge probably is the most significant - the flow is small (o.157 mgd) but the receiving stream (Canoe Creek [17B]) also is small. Water from coal washeries also may cause problems in Clarion and other counties, but this is discussed in the section on acid mine drainage. The sampling stations on the Clarion River in Clarion County (WQN Stations 821 and 843) show high concentrations of manganese and zinc - this may be due in part to acid mine drainage.

Elk County does not have as many industrial discharges as some of the more urbanized counties but, nevertheless, has several problem areas from industrial wastes. There are five industrial facilities with a total flow of over 1.4 mgd in St. Marys, where the average flow in Elk Creek (17A) is only about 20 cfs (13 mgd). Much of the waste flow is from carbon companies and has high heavy metal concentrations. Several chemical company discharges occur in Ridgway, at the confluence of Elk Creek and the Clarion River (17A). Several fish kills have occurred in this area, attributed to chemicals and metals from industrial operations. However, the WQN sampling station on Elk Creek (844) does not show particularly high levels of heavy metals and the fish kills probably represent spill events or periodic discharges rather than continuous discharges. The largest industrial discharge in Elk County is Penntech Paper, located on Riley Run, a tributary of the Clarion River near Johnsonburg (17A). The large flow (13 mgd) and high BOD loading of the wastes cause Riley Run to be severely depressed and cause occasional low dissolved oxygen levels in Clarion River.

Forest County has only three industrial discharges, none of which has a major impact on water quality.

Jefferson County also has very few industrial discharges. None has major impacts on water quality other than the concentration of plating industries in Punxsutawney which causes problems with the sewage treatment plant and may be responsible for several fish kills in Mahoning Creek at Punxsutawney (17B).

Lawrence County is one of the urban and industrial centers of the study area, with a large concentration of industries in the New Castle area and many other industrial facilities scattered throughout the county. In the New Castle area, 11 facilities contribute 1.87 mgd of wastewater to the Shenango River (20A) and nearby tributaries. Only one of these facilities, Rare Earth, Inc., is listed as having a severe impact on water quality. Other major facilities in the county are the U. S. Steel facility at Ellwood City on Connoquenessing

Creek (20C), which, with a flow of 5.73 mgd carrying several pollutants including BOD, has a potentially severe impact on water quality. There are two major discharges from limestone companies; these are discussed in the mineral extration section. Of the streams in the county, the Mahoning River (20B) has serious water quality problems due to both industrial and domestic wastes, but most of the waste stems from the Youngstown-Struthers-Gerard area in northeastern Ohio. The pollutant load from the Mahoning seriously affects quality of the Beaver River (20B), formed by the confluence of the Shenango and Mahoning Rivers just below New Castle, so that the effect of the industries in the New Castle area and the effect of the U. S. Steel plant is difficult to determine.

Mercer is the most heavily industrialized county in the study area, with most of the discharges occurring along the Shenango River (20A). Six industrial facilities contribute 0.703 mgd to the Shenango at Greenville. One of these facilities, Damascus Tube/Sharon Steel, has a potentially severe impact on water quality from heavy metals. In the Sharon-Farrell area, 9 industries have a total waste flow of 92.143 mgd. Almost all of this flow is from one industrial source - the 87.56 mgd from Sharon Steel, by far the largest single industrial waste flow in the study area. Slightly over 20 mgd of this flow is cooling water and is relatively clean, although the temperature is 28° C. The rest of the flow is process water, containing a number of pollutants... The high heavy metal concentrations found in the Shenango River in Mercer County probably are attributable largely to this plant since there is no appreciable acid mine drainage, although contributions from other plants in the area are not inconsiderable, notably from the Sawhill Tubular Pipe Plant. Several fish kills have occurred in the Sharon area, but not particularly severe ones; apart from the heavy metals and high nutrient levels probably caused by municipal wastes, the Shenango River is in fairly good condition, indicating that even very large flows of industrial wastes will not impair water quality if proper control measures are taken (e.g., for heavy metals).

Venango County has a heavy industrial concentration in the Oil City-Franklin area with only a few industrial waste discharges elsewhere in the county. Seventeen industries discharge 5.5438 mgd of industrial wastewater into the Allegheny River and its tributaries in the Oil City-Franklin region (16D, G, E). Of the streams in the area, Oil Creek (16E) is the most severely affected. Oil Creek is in excellent condition throughout most of its length, but the last two miles before its confluence with the Allegheny have poor conditions from oil pollution and related petroleum activities. French Creek (16D) actually receives more waste flow, including the 3.11 mgd flow from the Franklin Steel Division of Borg Warner. Fish kills have been recorded in both French and Oil Creeks, but not in the Allegheny itself - apparently the large, relatively clean flow of the Allegheny is enough to dilute the effect of the industrial wastes. Another major industrial waste discharge occurs at Emlenton, where the Quaker State Oil Refinery has a 5.25 mgd discharge into the Allegheny. This discharge is listed as potentially severe, but no data exist to indicate adverse effects on the Allegheny.

2.1.6.6. ACID MINE DRAINAGE AND CONTROL

A. Introduction

The effect of acid mine drainage on streams is the single most severe water quality problem in western Pennsylvania. Acid mine drainage can occur in association with several types of mining, e.g., copper, gold, zinc and sulfur (41) but predominantly it is a problem of the coal mining industry. Chemically it can be described as the effluent originating from a coal seam and containing (3) (42) (43):

· Low	pH	-log (H+ Conc)	2 - 6
· High	acidity	Titratable acid	Over 2,000 milligrams per liter
· High	ferrous iron	(Fe^{2+})	10 - 3,000 milligrams per liter
· High	total iron	($Fe^{2+} + Fe^{3+}$)	0 - 9,300 milligrams per liter
· High	sulfate	(SO_4^{--})	22 - 9,700 milligrams per liter
· High	aluminum	(Al^{3+})	0.1 - 530 milligrams per liter
· High	manganese	(Mn ions)	0.04 - 127 milligrams per liter
· Low	bicarbonate	(HCO_3^-)	0 - ? milligrams per liter
· Low	alkalinity	Titratable base	0 - 720 milligrams per liter
· High	hardness	($CaCO_3$)	Over 1,000 milligrams per liter

To the eye, acid mine drainage is indicated by a reddish-yellow scum called "yellowboy" which stains the beds of streams. The water becomes toxic to fish, irritates the eyes and skin of those that use the rivers for recreation, and is unsuitable for drinking.

The origin of acid mine drainage is pyritic (iron sulfide) material occurring in the coal bearing strata. If left to erode naturally this material would oxidize slowly and only slight natural acid drainage would be detectible in streams. In fact, the natural occurrence of yellowboy was used by early coal explorers to locate buried coal seams (3). However, the importance of coal to the economy over the past 200 years has meant extensive mining, and large quantities of pyrite overburden have been disturbed and exposed to the air. Oxidation of the exposed pyrite has taken place at an accelerated pace and outstripped the capacity of the environment to assimilate the acid drainage through the neutralizing effect of limestone and dolomite occurring within the coal-bearing formations. Although only about half of the coal mines in western Pennsylvania have a mine discharge which is acid by EPA standards ($pH < 6$) (44), the result has been a severe degradation of the quality of the streams in producing areas - a degradation that has followed America's search for coal even up to this decade.

Currently the coal industry is undergoing a rebirth after half a century of decline. Coal production in 1978 has regained the production level of 1913 (45) but this time it has a more sophisticated technology and is the focus of a national energy plan. To trace the rise and fall of coal before this latest resurgence, let us go back to the beginning of the United States as a country, before the Revolution:

> The earliest recorded coal mining in the United States occurred in 1701, near Richmond, Virginia, but commercial mining of coal did not begin in this country until 1745. Coal was discovered in Ohio in 1755...(46).
>
> There was no other important production until 1759 when a coal mine was opened on the Monongahela River opposite Fort Pitt, now Pittsburgh (47).
>
> In 1770 George Washington commented on an Ohio Coal mine he had seen. Yet with concentrated deposits of coal available for exploitation, at presumably very low cost, coal still did not make significant inroads into the market for fuels. In fact, even with American deposits of coal having been identified, most of the coal used in America up until the Revolution was imported from England or Newfoundland. The shortage of coal occasioned by the break with England spurred the growth of American coal mining during the Revolution. Government requisitions of coal in Pennsylvania and

Maryland, to support the manufacture of munitions, stimulated the beginning of American coal mining as an industry. Thus the industry began, not as a natural response to price but as the result of a shock - the loss of English coal during the Revolutionary War.

A great discovery of coal was made in 1810 when an unusually violent freshet unearthed a huge coal seam, now believed to have been the Pittsburgh seam, near the town of Barton (Ohio). Coal from this seam was hauled by wagon as far east as Romney (West Virginia) and Winchester (Virginia). Later it was hauled overland to Westernport (Maryland) where it was placed on barges and rafts and shipped to Washington (D.C.). Yet, even with these early discoveries of coal in rich deposits, where fuel could be picked from the surface of the ground, coal production did not make significant inroads in the market for fuels (46).

In 1793 the United States produced about 63,000 tons of coal which was mined mainly in Pennsylvania and West Virginia (47).

It was not until 1850 that coal production reached 10 percent of the fuel provided by firewood (46).

Beginning in the mid 1850's the use of coal as an industrial fuel grew rapidly. In 1840, when the first Federal census was taken, coal production was approximately 2,000,000 tons. From 1841 to 1869 annual production grew to about 15,000,000 tons (47).

By 1885 coal production surpassed firewood production and continued to grow vigorously (46).

In the period, roughly 1890 to 1920, coal mining was one of the Nation's most rapidly growing industries. Production approximately doubled every 8 to 10 years but following the first World War peak, reached in 1918, the general long time trend has been downward... In 1900 coal contributed 89 percent of the energy derived from the mineral fuels (coal, oil and gas) and water power. By 1937 this had dropped to 54 percent. Natural gas and petroleum contributed 43 percent and water power 3 percent (47).

In about 1920, the production of oil and natural gas, and their use as industrial fuels began a growth that ultimately exceeded even the previous growth in the use of coal. As coal had replaced wood as the principal industrial fuel, so oil and gas came to replace coal (46).

A dramatic turn in the development of coal took place in 1973-74 when the oil embargo was imposed on the United States of America. By this time the contribution from coal to the United States energy consumption had dropped to 19 percent and was overshadowed by natural gas and petroleum which had risen to 75 percent (48). The effect of the embargo and other changes can be seen in the readjustment of energy sources in Pennsylvania between 1974 and 1975. The contribution from coal increased 2.1 percent and the hydro/nuclear contribution increased 2.8 percent, while petroleum and natural gas contributions dropped 2.7 percent and 1.3 percent respectively (49). Funds spent on coal research by the Federal government in 1974 were equivalent to the combined budgets of the previous 13 years for such research (45). In 1977 a major thrust back to coal commenced when President Carter took office with a proposed national energy plan to relieve United States dependence on foreign petroleum and natural gas. This was in the atmosphere of a renewed increase in national energy consumption after the temporary decline following the oil embargo and the economic recession (49).

Pennsylvania is particularly sensitive to a renewed emphasis on coal because of the large resources located in the state. However, it has been argued that the new thrust has done more to shift the energy source from natural gas to oil in 1977 than to coal.

> Industries experiencing plant closings because of wintertime gas cutoffs have switched in substantial numbers to fuel oil, propelling a 14.5 percent increase in the demand for residual oil (50).

On the other hand, as Charles Berg has pointed out, historically the change of a fuel source may have as much to do with increased opportunity to develop new and more productive processes, as with competitive cost (46). The inventive minds which have been attracted to coal as a "new energy source" are evidenced by their work in coal gasification and coal liquefaction. Scientists and engineers have also researched the pollution problems of coal as in the case of sulfur dioxide scrubbers and the treatment of mine drainage. The Research and Development budget for coal research within the Federal government has grown strongly since 1974 and has now reached half a billion dollars annually (45).

So the return to coal as a major source of energy may be the prospect for the close of the 20th century. Beyond is solar energy, wind and other renewable energy sources and perhaps a break with the traditional idea or a centralized energy distribution system. But for now the political and long-term economic forces are placing coal in the spotlight, including a focus on the environmental consequences of coal mining and conversion. Acid mine drainage along with sulfur dioxide emissions are front runners in that controversy.

B. History of Acid Mine Drainage and Control

1900 - 1940

The history of acid mine drainage closely paralleled that of the coal industry in the early years. Acid loads in the rivers increased in proportion to the cumulative tonnage of coal mined. For example, Figure 2.1.6.-33 shows the rise in acidity (methyl orange) levels in the Monongahela River in relation to the cumulative production of coal between 1917 and 1940.

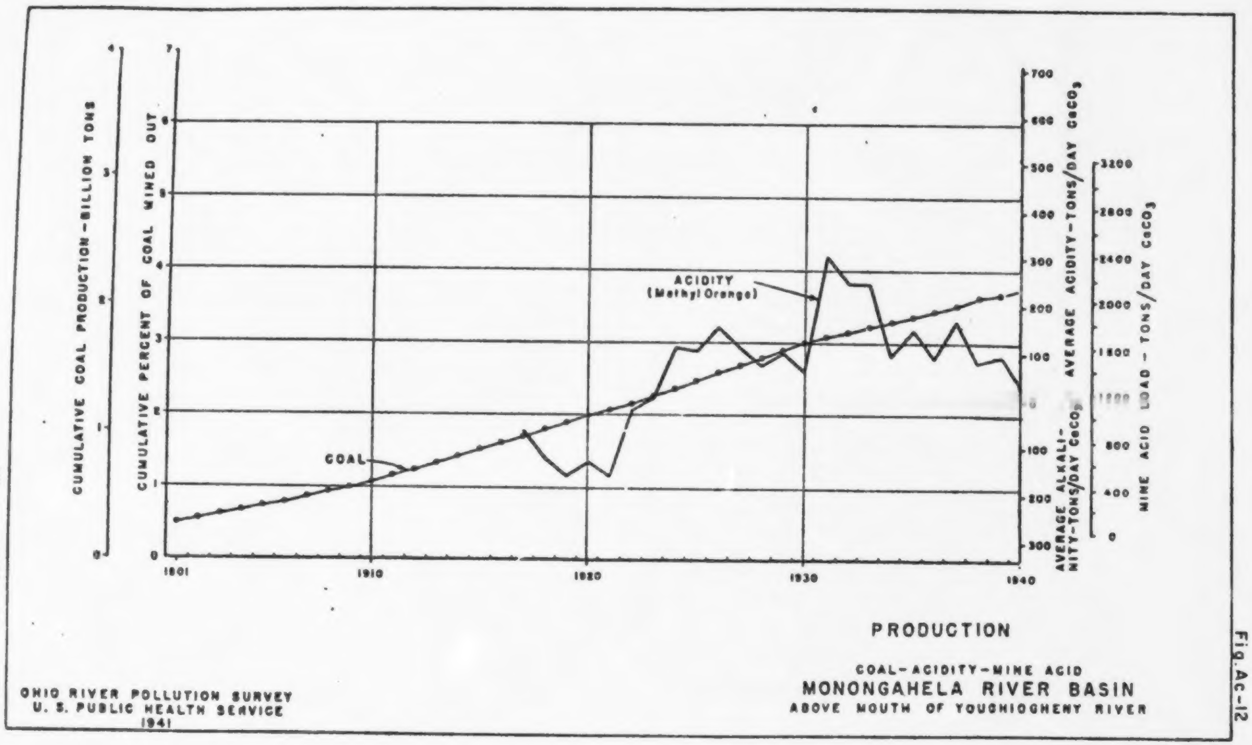
While it was no great problem in 1900, acid mine drainage made its presence felt by 1910. By 1920, the Kiskiminetas and Youghiogheny Rivers became acid and the upper Monongahela River was soon to follow. In the high-acid year, 1934, the Allegheny River, which at that time had a natural alkalinity of 25 parts per million, barely missed becoming acid in average quality (47). Figure 2.1.6.-34 shows the acidity in the Monongahela River from 1931-1947. The acidity (methyl orange) is expressed in milligrams per liter calcium carbonate equivalent (23). The Figure also illustrates the adrupt drop in acidity in the Monongahela River in 1939 when the Tygart Reservoir (in its headwaters) became operational.

Coal mines were responsible for 98% of the acid load discharged to streams in the upper Ohio River Basin in 1940. The balance originated from spent pickle

FIGURE 2.1.6.-33

COMPARISON OF CUMULATIVE COAL PRODUCTION AND
FLUCTUATION IN MONONGAHELA RIVER ACID LEVELS: 1917-1940

Source (47)



PRODUCTION

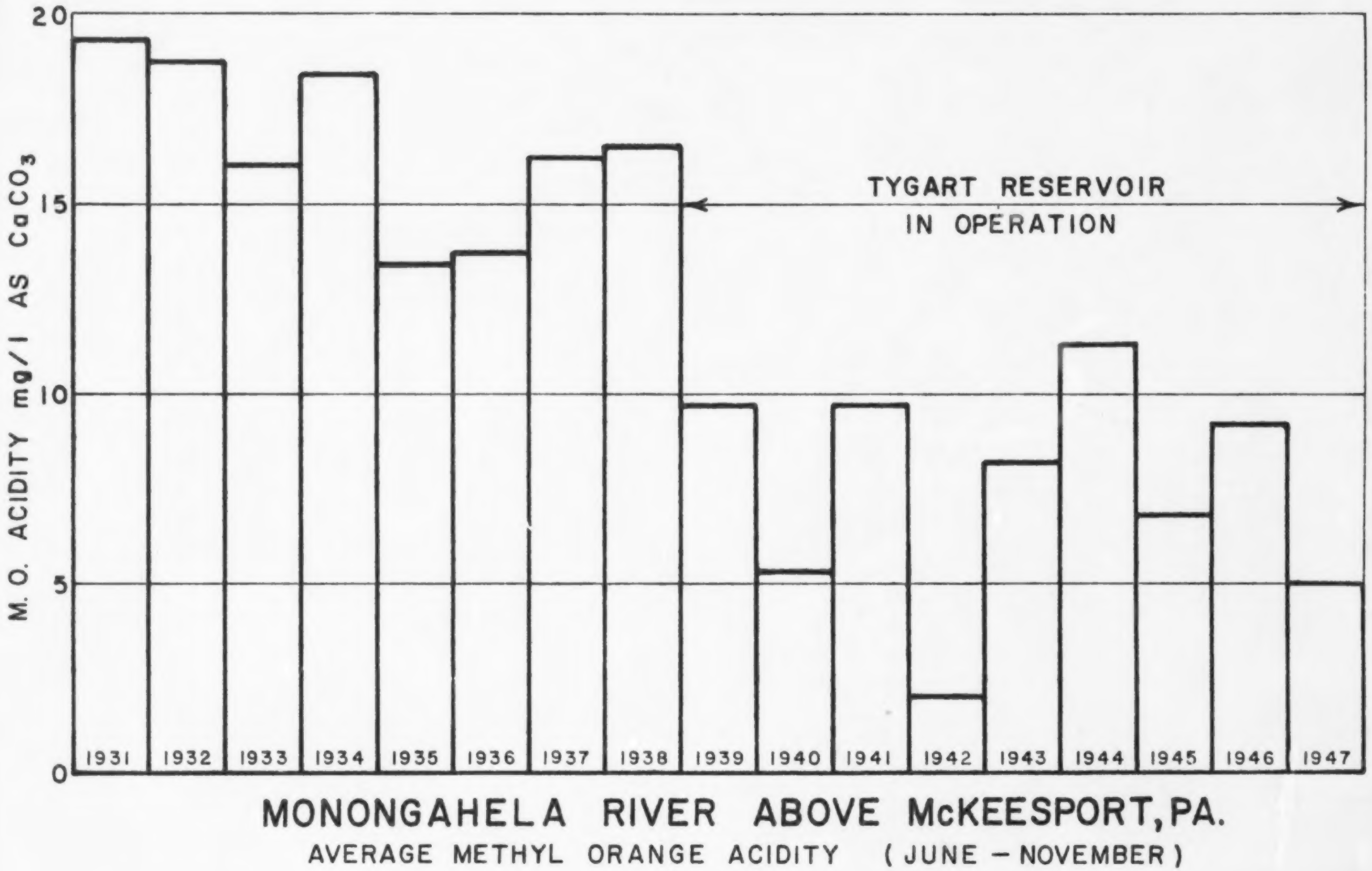
COAL-ACIDITY-MINE ACID
MONONGAHELA RIVER BASIN
ABOVE MOUTH OF YOUGHIOGHENY RIVER

OHIO RIVER POLLUTION SURVEY
U. S. PUBLIC HEALTH SERVICE
1941

Fig. Ac-12

(Face p. 1020) GPO-43 O-98035

FIGURE 2.1.6.-34 ACIDITY LEVELS IN THE MONONGAHELA RIVER: 1931-1947 Source (23)



liquor discharged by the metallurgical industry and natural contributions of humic acids from swamps. The heaviest concentrations of acid occurred in the Monongahela River and the Kiskiminetas River which had the distinction of being the most acid major Ohio tributary basin, and the most acid large stream respectively (47). Table 2.1.6.-49 shows the acid load in the upper Ohio Basin compared to the Ohio River itself. The bulk of the load came from mine discharge, some of which was removed by sealing of abandoned mines.

In general, pickle liquor was a minor source of acid compared to the acid mine drainage except in the case of the Beaver River, which flows through the steel industry complex in Youngstown, Ohio. Here pickle liquor was responsible for almost half of the acid load discharged into the water. Along the Ohio mainstem the contribution from this source was under 9% and in the Allegheny and Monongahela Rivers it was about 1%.

Abandoned mines were a very significant source of the mine acid load in 1940. Table 2.1.6.-50 shows the contribution from abandoned mines in the major streams of the Upper Ohio Basin. It also indicates the reduction of acid load made possible by the sealing of some of the abandoned mines.

Abandoned mines were responsible for more than half of the mine acid load in the upper Allegheny and Beaver Rivers, about one-third in the upper Monongahela, and about one-quarter of the load in the Kiskiminetas and Youghiogheny tributaries. Active mines were the source of the balance of the load. The sealing program

TABLE 2.1.6.-49

1940 ACID LOADS IN THE UPPER OHIO BASIN COMPARED TO THE OHIO RIVER MAINSTEM

After Source (47)

River	Original Mine Acid Load	Removal By Sealing	Residual Mine Acid Load	Pickle Liquor Acid Load	Total Acid Load	Mine Contribution By River
	Tons per Year (as $CaCO_3$)					Percent*
Allegheny	405,150	29,704	375,446	3,375	378,821	34.9
Monongahela	920,656	274,642	646,014	7,125	653,139	60.0
Beaver	17,388	2,280	15,108	8,000	23,108	1.4
Ohio in PA	49,397	9,030	40,367	5,840	46,207	3.7
Total Upper Ohio Basin**	1,392,591	315,656	1,076,935	24,340	1,101,275	100.0
Ohio Mainstem***	230,430	53,966	176,464	15,000	191,464	-

*Contribution from residual acid mine load expressed as a percentage of the total residual load upstream of the Pennsylvania/Ohio/West Virginia border.

**Upstream of the Pennsylvania/Ohio/West Virginia border.

***Minor tributaries and direct drainage of entire mainstem.

TABLE 2.1.6.-50

ABANDONED MINE ACID LOAD AND REMOVAL (IN 1940) DUE TO SEALING PROGRAMS IN THE UPPER OHIO RIVER BASIN

After Source (47)

River	Original Mine Acid Load	Abandoned Mine Load		Removal By Sealing	
	Tons/Yr*	Tons/Yr*	%	Tons/Yr*	%
Allegheny - except Kiskiminetas	83,461	50,244	60	18,750	22
Kiskiminetas	321,689	73,988	23	10,954	3
Monongahela - except Youghiogheny	700,972	223,634	32	251,900	36
Youghiogheny	219,684	52,340	24	22,742	10
Beaver	17,388	10,920	63	2,280	13

*As $CaCO_3$

could be regarded as successful in the upper Monongahela, where the reduction matched the contribution from abandoned mines. Elsewhere the removal was significantly out of pace with abandoned mine drainage, especially in the Kiskiminetas River.

The remedial measures used around 1940 were mine sealing and flow regulation by reservoirs. Field studies were started in 1925 by the Bureau of Mines to find the means to prevent acid formation by sealing abandoned mines. Large scale sealing commenced in 1933, based on the principle of excluding air to prevent oxidation of the pyrite, marcasite and other sources of sulfur, occurring in association with coal seams. In addition, surface water was diverted from entering the mines through cracks or caves. Burke and Downs (47) proposed the reaction responsible for acid mine drainage as:

$$2FeS_2 + 7O_2 + 2H_2O = 2FeSO_4 + 2H_2SO_4 \qquad \text{(Eq. 1)}$$

$$\text{Pyrite + Oxygen + Water} \longrightarrow \text{Iron Sulfate + Sulfuric Acid}$$

The damage from the acid was assessed in terms of the cost of repairing corrosion of equipment on the rivers. Other consequences included the site suitability of food and textile industries, and the loss of aesthetic and recreational value of the river which, however, were not possible to be given a dollar value. Table 2.1.6.-51 demonstrates the cost due to acid mine drainage in terms of the damages that could be given a monetary value. It totalled over $2 million damage in Pennsylvania in 1940. By way of comparison $2,666,000 were spent up till that time on mine sealing in the Upper Ohio River Basin by the Works Progress Administration (47).

TABLE 2.1.6.-51

1940 COST OF DAMAGE DUE TO ACID MINE DRAINAGE IN THE UPPER OHIO RIVER BASIN*

Source (47)

Industry	1940 $ Per Year
Domestic Water Supplies	364,000
Industrial Water Supplies	407,000
Steamboats and Barges	1,143,000
Power Plants	76,000
River and Harbour Structures	76,000
Floating Plant	5,000
Total	$2,071,000

*Upstream of the Ohio-West Virginia-Pennsylvania border.

Cure rather than prevention was the methodology of the day. Power plants, for example, found it cheaper to repair and replace their equipment for $76,000 than to neutralize the cooling water for $261,000 per year. Neutralization at the source, using limestone at the mine, had been tried as early as 1914 when a coal company near Mount Pleasant, Pennsylvania set up a treatment plant (51). However, due to economic reasons, the practice of treating acid mine drainage did not gain acceptance until half a century later.

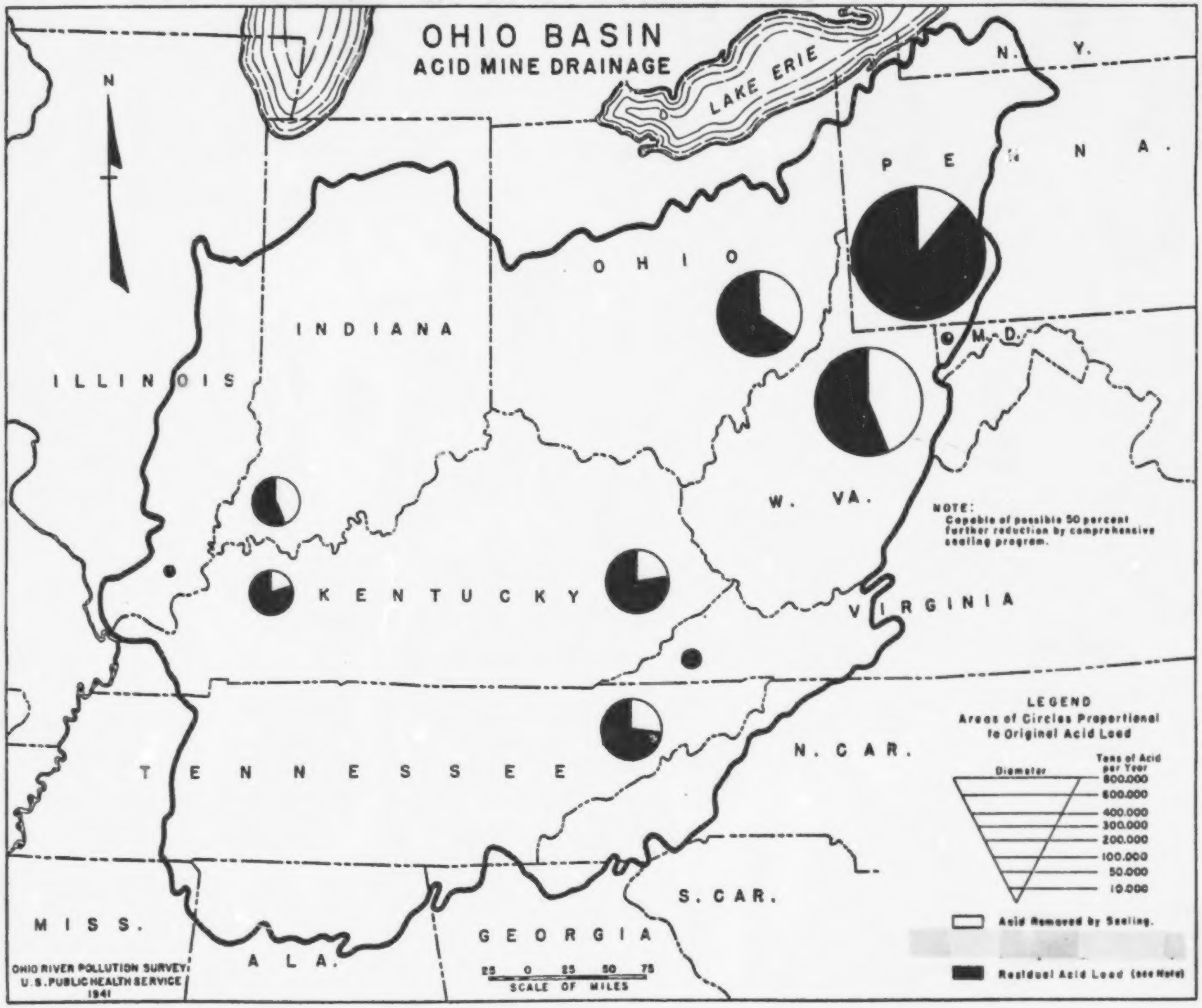
Pennsylvania and West Virginia were the biggest mine drainage problem areas in the Ohio basin, as can be seen on Figure 2.1.6.-35. The acid load from mines was approximately 1,400,000 tons per year, and after 23% was removed by sealing programs, over 1 million tons were actually discharged to the streams in the upper Ohio Basin in 1940 (47).

The major problem areas were the Kiskiminetas River and the upper Monongahela River. The Kiskiminetas was responsible for 83% of the Allegheny Basin mine acid load and recorded a minimum pH of 2.9 at its mouth in 1940. The lowest pH in the Kiskiminetas drainage area was pH 2.4 in Blacklick Creek. This was the lowest pH recorded for the Upper Ohio River Basin that year. A similarly low pH of 2.5 was recorded in the upper Monongahela drainage area at Cats Creek (Masontown, Pa.). The upper Monongahela River (above the Youghiogheny) contributed 70% of the Monongahela basin acid mine load and had an average pH of 4.2 in the mainstem.

The Ohio River itself showed worsening water quality due to acid mine drainage. Back in 1914 acid conditions had been occasionally observed downstream as far as Wheeling, West Virginia (River Mile 90). By 1940, acid mine drainage affected the Ohio as far west as the mouth of the Kanawha River (River Mile 266) (47). The upper 100 miles of the Ohio was acid for a considerable part of the time in 1940 because of mine drainage. The river had to assimilate a

FIGURE 2.1.6.-35 COMPARISON OF MINE ACID LOADS BY STATE IN THE OHIO RIVER BASIN IN 1940-Source (47)

Fig. Ac-2


OHIO BASIN
ACID MINE DRAINAGE
LAKE ERIE
N. Y.
PENNA.
OHIO
INDIANA
ILLINOIS
M. D.
W. VA.
VIRGINIA
KENTUCKY
TENNESSEE
N. CAR.
S. CAR.
GEORGIA
ALA.
MISS.
N
NOTE:
Capable of possible 50 percent further reduction by comprehensive sealing program.
LEGEND
Areas of Circles Proportional to Original Acid Load
Diameter
Tons of Acid per Year
800.000
600.000
400.000
300.000
200.000
100.000
50.000
10.000
Acid Removed by Sealing.
Residual Acid Load (see Note)
25 0 25 50 75
SCALE OF MILES
OHIO RIVER POLLUTION SURVEY
U.S. PUBLIC HEALTH SERVICE
1941

further 120,000 pounds per day of pickle liquor discharged by the 62 steel plants situated predominantly along this stretch (47).

1940 - 1960

The abatement of acid pollution lagged other pollution clean-ups because of the already acid condition of the streams and the depressed economy of coal mining regions. In 1947, 99% of the samples of the Kiskiminetas River contained free acid ($pH < 4.5$). This caused a drop in minimum pH in the Allegheny River from 6.5, above the mouth of the Kiskiminetas, to less than 5.6 for 45 days of that year, downstream of the mouth (30).

The Monongahela suffered a handicap in comparison to the Allegheny Basin. It does not have a high upstream alkalinity and the acid intensity (tons per square mile) at that time was about four times that of the Allegheny River (47). Consequently, pH levels upstream of the Youghiogheny River registered free acid for an average of 166 days per year during 1943-1949 (30). The Youghiogheny itself demonstrated free acid conditions about 50% of the time in 1947-48 at Sutersville (30).

The Beaver River was relatively dilute and free of acid because of the influence of the Mahoning and Shenango Rivers. However, although the water seldom dropped to free acid conditions, the high sulfate content indicated that interaction of sulfuric acid, from mine drainage, was taking place with bicarbonate in the river, and thereby depleting the Beaver's alkalinity (30).

The Pennsylvania program to regulate mining began in 1945 when discharge into unpolluted streams was prohibited (18). However, already polluted streams were exempted from this legislation and the control of existing operations was not attempted. This was due to the widely held belief that the control of acid mine drainage would be futile, until complete answers regarding the complex reactions involved had been developed through research. This attitude was so entrenched that in 1955, when ORSANCO (Ohio River Valley Sanitation Commission) adopted basic requirements for the control of industrial wastes, mine drainage was specifically exempted "until such time as practical means are available for control." (52)

1960's

Five years later (1960) ORSANCO removed the special exemption for acid mine drainage because the concept of ameliorating conditions by applying knowledge-at-hand gained acceptance (52). Monetary damage to industry and river structures during the early sixties in the Monongahela Basin alone was $2,251,000 annually (16). The standards for mine drainage and industrial acid and iron discharges were upgraded statewide in 1963.

A study undertaken in August of that year by the Public Health Service (16) showed that the Monongahela River acid loads were not significantly different from the 1940 loads with some values for 1963 exceeding those of 1940 and the reverse at other stations. The results of both the 1940 and the 1963 measurements are displayed in Figure 2.1.6.-36. The 1940 acidity is given at the side of each bar graph for 1963 acidity.

In the case of the Youghiogheny River there was a general improvement between the acid loads of 1940 and 1963. The Youghiogheny measurements are shown in Figure 2.1.6.-37. In Maryland the mainstem was alkaline but Laurel Run, an interstate tributary in the headwaters, was acid and caused a water supply problem for Oakland, Maryland. In Pennsylvania the mainstem was acid, but the loads were generally less than in 1940. However, the Sutersville station near the mouth of the Youghiogheny showed a triple increase in acid load. (This may have been due to the load from Sewickley Creek just upstream of the station.) The Casselman River was alkaline in its upper reaches but the stream deteriorated due to acid mine drainage in Pennsylvania.

FIGURE 2.1.6.-36

1963 ACIDITY AND ALKALINITY IN THE MONONGAHELA RIVER

- - -

1940 ACIDITY COMPARISON

Source (16)

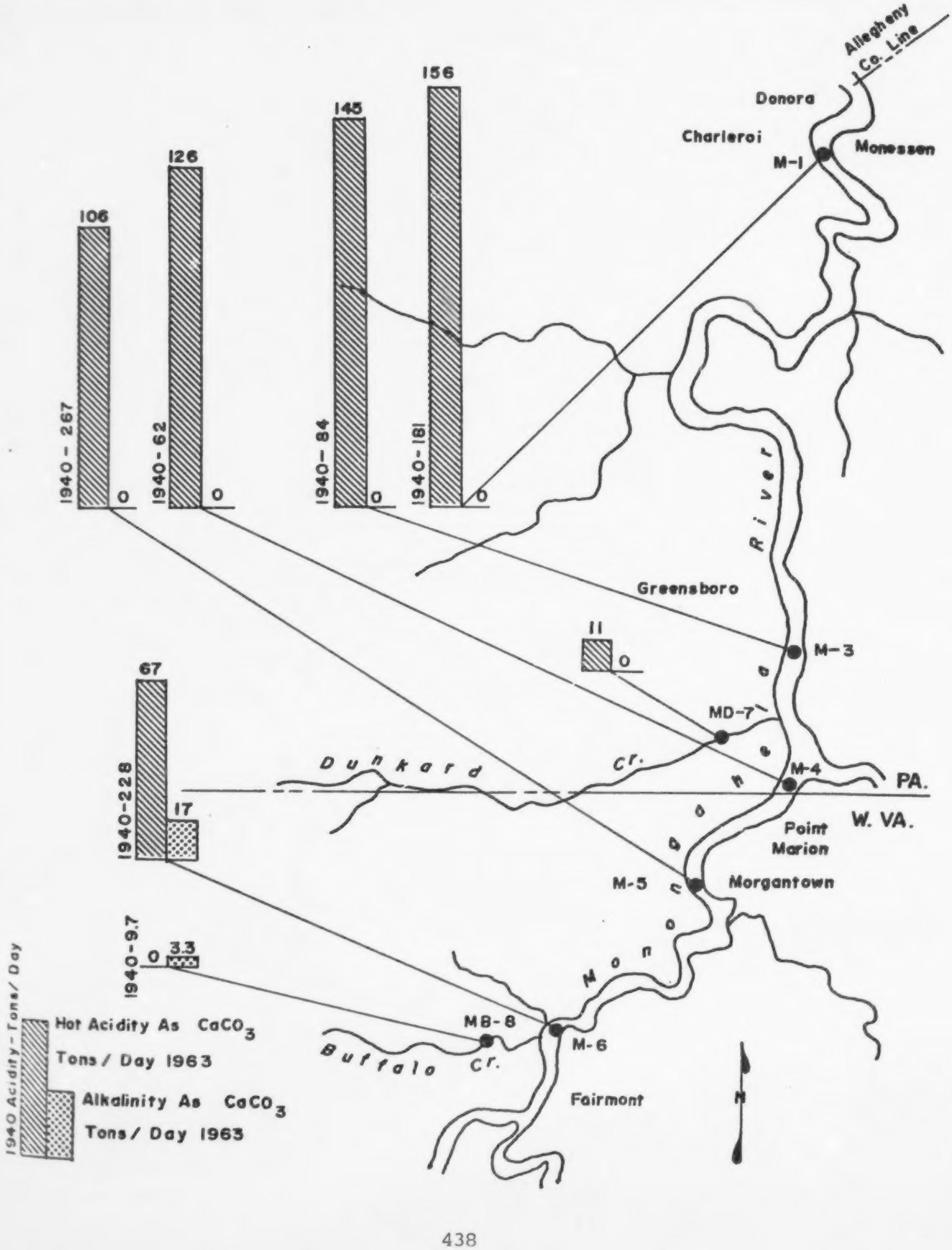

Allegheny Co. Line
Donora
Charleroi
Monessen
M-1
156
145
126
106
1940 - 267
0
1940-62
0
1940-84
0
1940-181
0
River
Greensboro
11
0
M-3
MD-7
67
Dunkard Cr.
M-4
PA.
W. VA.
1940-228
17
Point Marion
M-5
Morgantown
Monongahela
1940-9.7
0
3.3
MB-8
M-6
Buffalo Cr.
Fairmont
N
1940 Acidity - Tons/ Day
Hot Acidity As $CaCO_3$
Tons / Day 1963
Alkalinity As $CaCO_3$
Tons / Day 1963

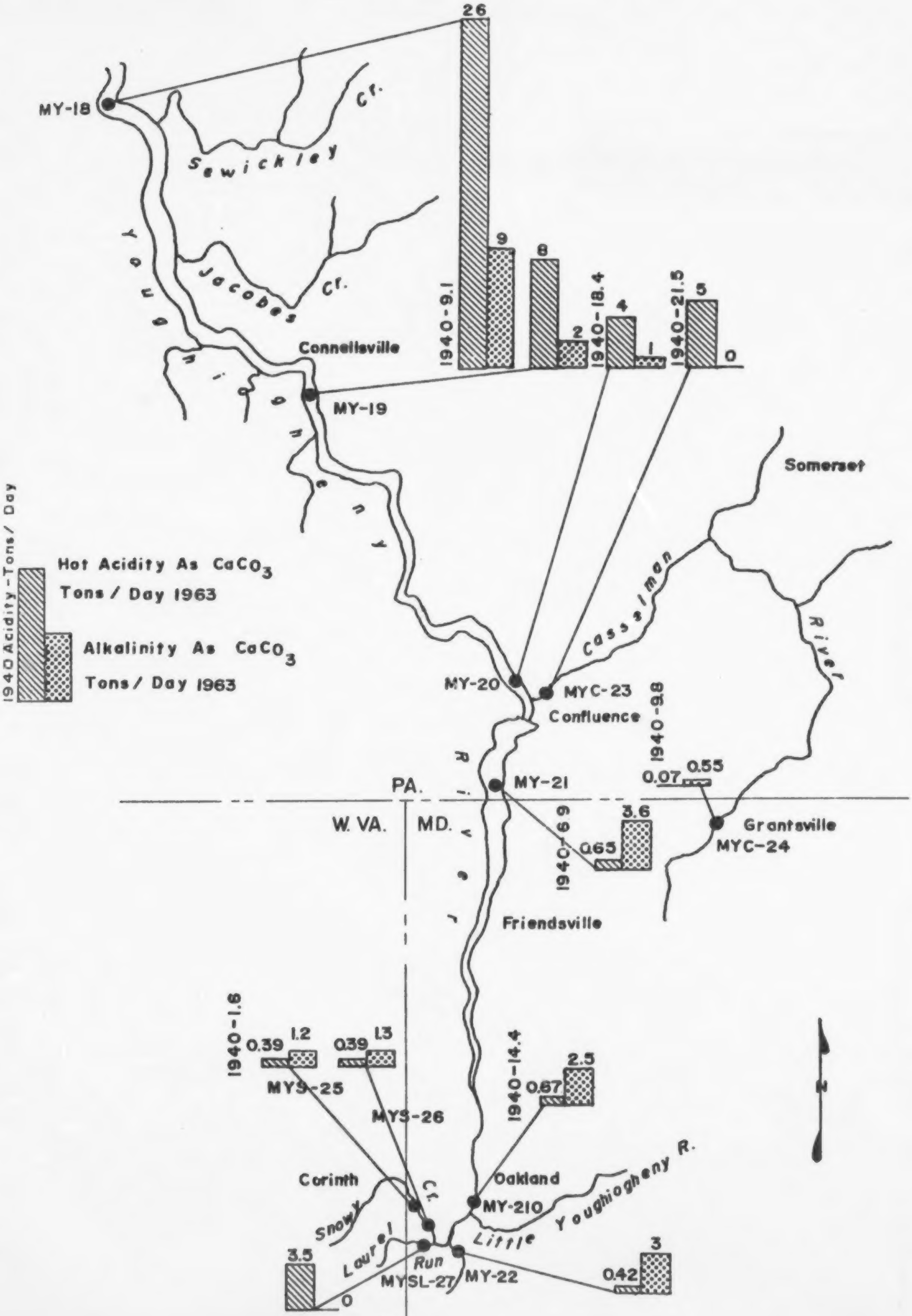
FIGURE 2.1.6.-37

1963 ACIDITY AND ALKALINITY IN THE YOUGHIOGHENY RIVER

- - -

1940 ACIDITY COMPARISON

Source (16)



26
MY-18
Sewickley Cr.
Youghiogheny
Jacobes Cr.
9
8
2
4
1
5
0
1940-9.1
1940-18.4
1940-21.5
Connellsville
MY-19
Somerset
1940 Acidity - Tons / Day
Hot Acidity As $CaCO_3$ Tons / Day 1963
Alkalinity As $CaCO_3$ Tons / Day 1963
Casselman
River
MY-20
MYC-23
Confluence
1940-9.8
0.07
0.55
PA.
MY-21
W. VA.
MD.
Grantsville
MYC-24
River
1940-6.9
3.6
0.63
Friendsville
1940-1.6
0.39
1.2
0.39
1.3
MYS-25
MYS-26
1940-14.4
2.5
0.67
N
Corinth
Cr.
Snowy
Oakland
MY-210
Little Youghiogheny R.
Laurel Run
3.5
0
MYSL-27
MY-22
3
0.42

An important amendment to the Clean Streams Law in 1965 gave the polluted streams of Pennsylvania the same protection as the unpolluted ones. The Department of Health required all active mine discharges to meet effluent standards. These were:

- pH range 6.0 - 9.0
- Total iron concentration not more than 7 milligrams per liter
- Alkalinity greater than acidity

A comparison between the observations in 1940 (47) and a study done in 1965 by the University of Pittsburgh (17) indicates small changes in the pH values in the Allegheny and Monongahela Basins. Table 2.1.6.-52 shows the comparative pH values in both the mainstem and major tributary in each basin. There was noticeable improvement in the Ohio River in Pennsylvania and in the Monongahela at its mouth, but the other rivers and tributaries showed only marginal increase in pH.

Despite this small progress in abatement, the area affected by acid mine drainage remained large. Figure 2.1.6.-38 shows the streams in the Allegheny Basin significantly affected by mine water in the late 1960's. More than 1,000 miles of streams in the watershed were affected to some degree by coal mining (51). In the Monongahela Basin the area affected is shown in Figure 2.1.6.-39. Between 1963 and 1970, pH and alkalinity improved significantly at Charleroi and Braddock (near Pittsburgh) on the Monongahela River, and at Sutersville and Connellsville on the Youghiogheny River. There was slight improvement at the Youghiogheny River Dam but no apparent change at Greensboro on the Monongahela (18). A map of this area is shown in Figure 2.1.6.-40.

TABLE 2.1.6.-52

COMPARISON OF pH VALUES IN THE UPPER OHIO RIVER BASIN BETWEEN 1940 AND 1965

After Sources (47), (17)

River	1940 (47)*		1965 (17)**	
	pH	Number of Samples	pH	Number of Samples
Allegheny above Kiskiminetas	7.3	14	7.3	57
Kiskiminetas	3.2	6	3.7	80
Allegheny Mouth	6.6	12	6.9	80
Monongahela above Youghiogheny	4.2	17	4.8	80
Youghiogheny	6.1	6	6.4	79
Monongahela Mouth	4.9	12	6.5	79
Ohio in Pennsylvania	5.4	22	6.8	80

*Source (47) samples were obtained at intermittent intervals during the period August-December 1940.

**Source (17) samples were obtained on a regular basis during the period October 1964 - September 1965 at approximately the same stations as used in Source (47).

FIGURE 2.1.6.-38

TRIBUTARIES OF THE ALLEGHENY RIVER AFFECTED BY
COAL MINE WASTES IN THE LATE 1960's

Source (51)

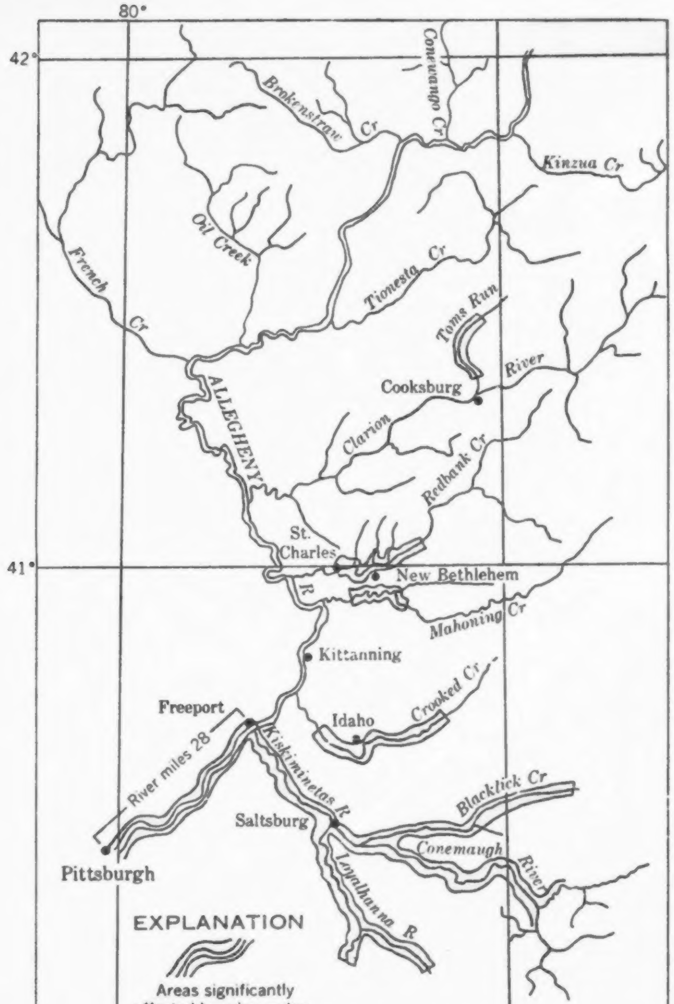

80°
42°
41°
40°
Brokenstraw Cr
Conewango Cr
Kinzua Cr
Oil Creek
French Cr
Tionesta Cr
Toms Run
Cooksburg
Clarion River
Redbank Cr
ALLEGHENY R
St. Charles
New Bethlehem
Mahoning Cr
Kittanning
Crooked Cr
Idaho
Freeport
River miles 28
Kiskiminetas R
Blacklick Cr
Saltsburg
Conemaugh River
Loyalhanna R
Pittsburgh
EXPLANATION
Areas significantly affected by mine water
20
0
20 MILES

FIGURE 2.1.6.-39

TRIBUTARIES OF THE MONONGAHELA RIVER
AFFECTED BY COAL MINE WASTES IN THE LATE 1960's

Source (18)

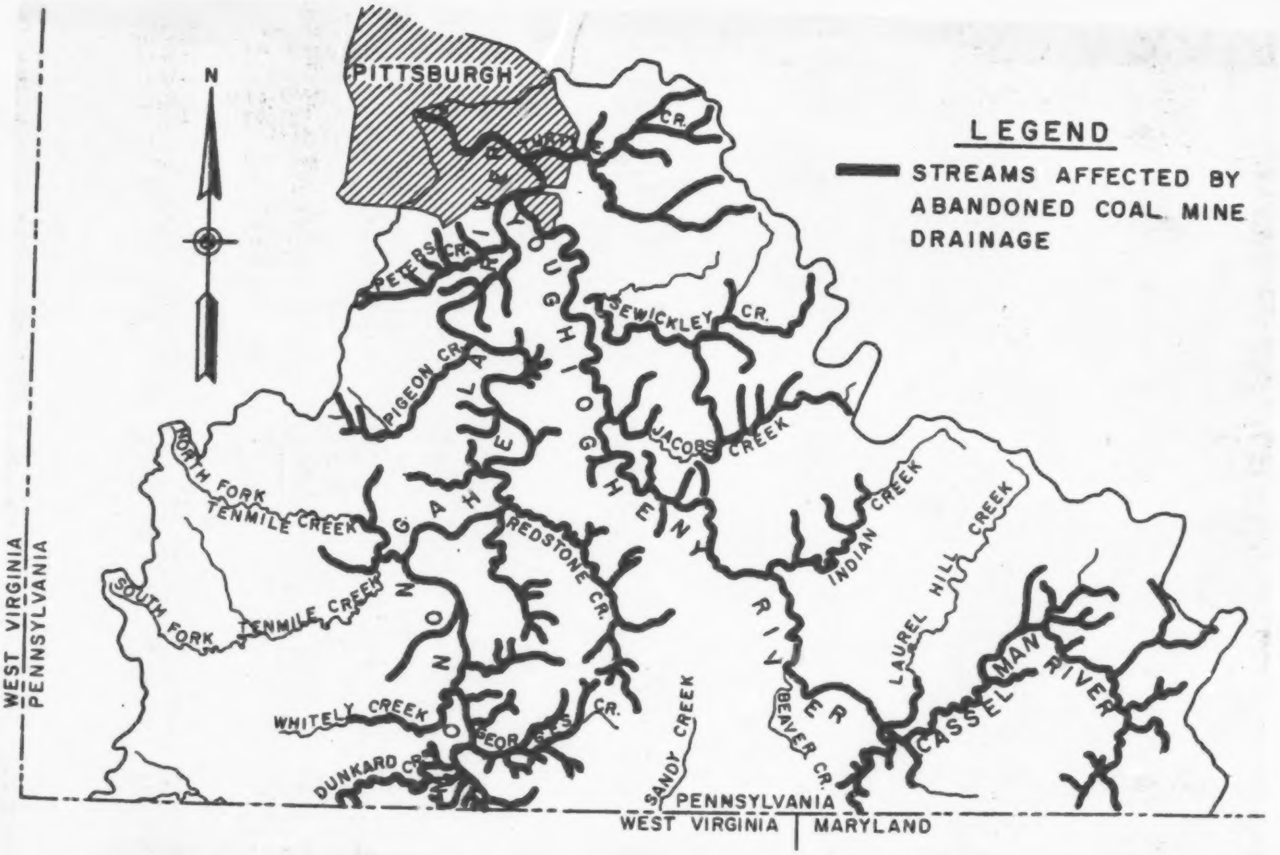
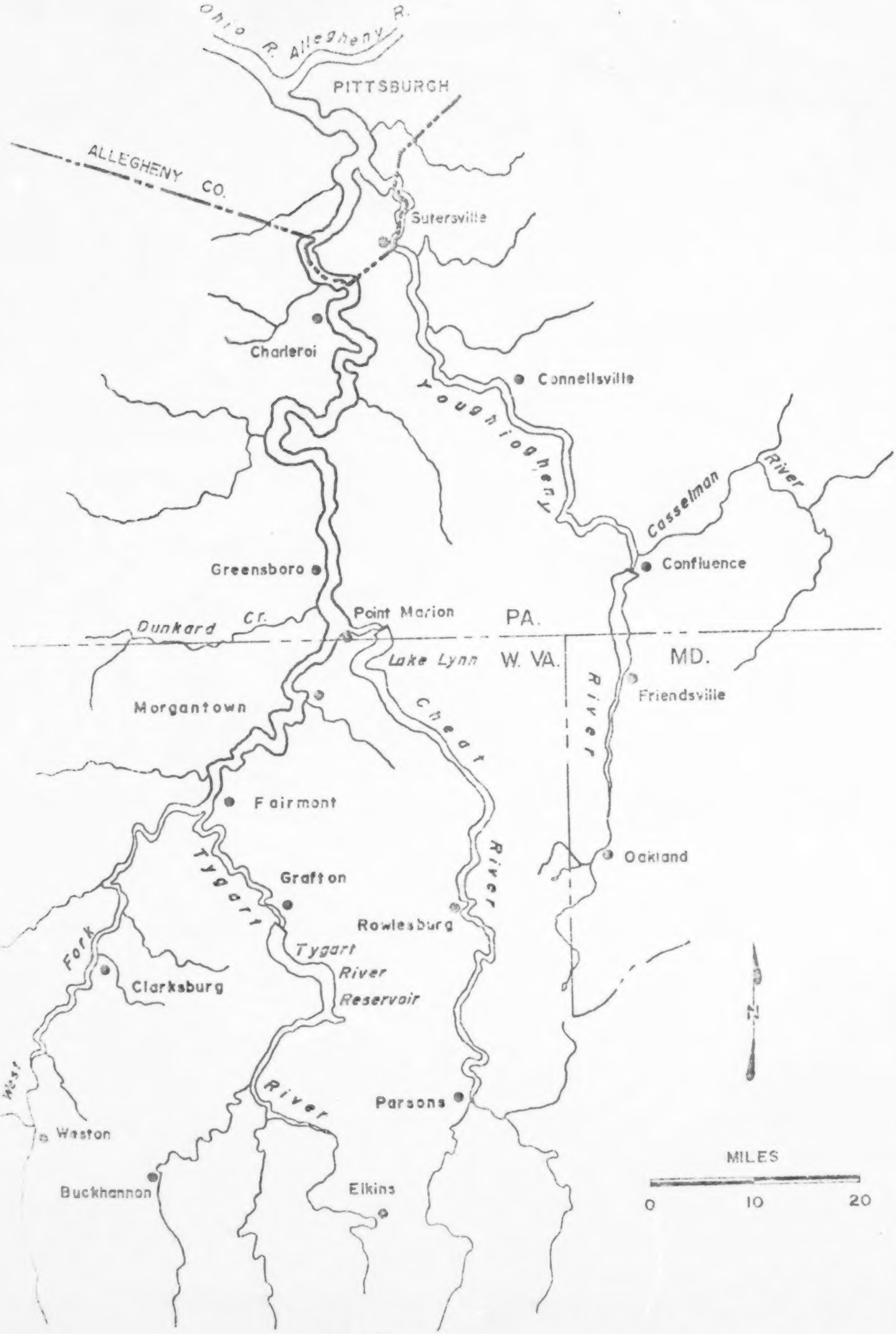

LEGEND
STREAMS AFFECTED BY ABANDONED COAL MINE DRAINAGE
N
PITTSBURGH
CR.
PETERS CR.
SEWICKLEY CR.
PIGEON CR.
JACOBS CREEK
INDIAN CREEK
LAUREL HILL CREEK
CASSELMAN RIVER
YOUGHIOGHENY RIVER
MONONGAHELA RIVER
NORTH FORK TENMILE CREEK
SOUTH FORK TENMILE CREEK
REDSTONE CR.
WHITELY CREEK
GEORGES CR.
DUNKARD CR.
SANDY CREEK
BEAVER CR.
WEST VIRGINIA
PENNSYLVANIA
PENNSYLVANIA
WEST VIRGINIA
MARYLAND

FIGURE 2.1.6.-40

MAP OF THE MONONGAHELA RIVER BASIN

Source (16)


Ohio R.
Allegheny R.
PITTSBURGH
ALLEGHENY CO.
Sutersville
Charleroi
Connellsville
Youghiogheny
Casselman
River
Confluence
Greensboro
Dunkard Cr.
Point Marion
PA.
Lake Lynn
W. VA.
MD.
River
Friendsville
Morgantown
Cheat
Fairmont
Tygart
Grafton
Oakland
Rowlesburg
River
Tygart
River
Reservoir
Fork
Clarksburg
West
River
Parsons
Weston
Buckhannon
Elkins
N
MILES
0
10
20

The U.S. Bureau of Mines began to study the neutralization of acid mine drainage in 1966 (53). Two years later "Operation Scarlift" got underway as part of a $500 million bond issue that was approved by the Pennsylvania legislature under the Land and Water Conservation and Reclamation Act of 1968. "Scarlift" provided for the expenditure of $200 million over a 10-year period to remove the land and water scars of past coal mining. Abandoned mine drainage was the target of the bulk of this allocation, to the tune of $150 million (2). Although some abatement projects had been funded by the Pennsylvania government prior to "Operation Scarlift," they were more moderate in scale and area. For example, approximately $85,000 was spent on 27 abatement projects in the Monongahela Basin between 1965 and 1971 (18). This covered Allegheny, Fayette, Somerset, and Westmoreland counties.

C. Current Status (1970's)

The 1970 amendments to the Clean Streams Law broadened control over potential pollution by requiring plans for treatment facilities for mine drainage before permits for mine operation were issued. The operation of a strip mine requires three permits:

- Mining license
- Surface mining permit for the specific location
- Water discharge permit (NPDES)

The first two permits are issued by the Bureau of Surface Mine Reclamation and require restoration of the site to its original contours. The third permit is issued by the Bureau of Water Quality Management and requires plans and engineering data which indicate the manner in which pollution will be prevented during and after the operation of the mine. Plans for treatment facilities must be included if the coal seam does not contain sufficient lime to treat the mine discharge naturally. Deep mine applications must include geologic structure maps showing the manner of mine development (including maintenance of barriers along outcrops) and pertinent hydrogeologic data regarding the sealing of the mine after completion (18).

The current standards for mine discharge are those of the National Pollutant Discharge Elimination System (NPDES) which requires:

- pH: 6.0 to 9.0
- Iron: no more than 7.0 mg/l
- Alkalinity greater than acidity
- Suspended solids: not more than 30 mg/l

The proposed Federal effluent standards for best practical control technology are as follows: (2)

	30-Day Average Maximum	Daily Maximum
pH	6.0 - 7.0	6.0 - 9.0
Total iron	3.5 mg/l	7.0 mg/l
Dissolved iron	0.3 mg/l	0.6 mg/l
Aluminum	2.0 mg/l	4.0 mg/l
Manganese	2.0 mg/l	4.0 mg/l
Nickel	0.2 mg/l	0.4 mg/l
Zinc	0.2 mg/l	0.4 mg/l
Total suspended solids	35.0 mg/l	70.0 mg/l

The number of facilities which have violated these standards since 1972 are listed in Table 2.1.6.-53 for the counties in the ORBES region in Pennsylvania. As can be seen from the Table about 11% of treatment facilities report incidents of stream pollution due to malfunctioning. However, this does not represent the true seriousness of the problem because there are many abandoned mines which have no drainage treatment facilities.

An exacerbation of the acidity problem is the neglect of treatment of sewage in acid streams. It has been known since as early as 1910 that acid mine drainage inhibits the growth of sewerage organisms. In 1971, 60% of the

TABLE 2.1.6.-53

RECENT* WATER QUALITY VIOLATIONS
AT ACID MINE DRAINAGE TREATMENT PLANTS IN WESTERN PENNSYLVANIA

After Sources (1), (2), (3)

County	Deep Mines		Surface Mines	
	Number of Violations**	Number of Facilities	Number of Violations***	Number of Facilities
Allegheny	1	5	1	13
Armstrong	0	12	15	81
Beaver	0	1	1	9
Butler	1	3	1	18
Cambria		13		
Clarion	0	1	12	98
Elk	0	1	2	11
Fayette	0	2	1	62
Forest	0	0	0	0
Greene	3	8	0	6
Indiana	3	18	1	48
Jefferson	0	2	3	54
Lawrence	0	0	0	16
Mercer	0	0	0	6
Somerset		6		
Venango	0	0	1	14
Washington	3	15	0	25
Westmoreland	1	5	1	47

*As of November 1975.

**Cited for violating stream quality standards.

***Occasionally violating stream quality standards, but not necessarily cited.

municipalities in Pennsylvania that discharged into acid streams did not treat their sewage, despite court orders. This was due to the low incentive to treat sewage where the improvement was difficult to detect because of the already degraded condition of the stream (18). The danger inherent in this practice is that acid streams, essentially devoid of biological populations, cannot effectively assimilate organic waste. The organic material is carried downstream unaffected until it reaches a "healthy" portion of the stream, where it often exerts too great a demand on the stream's oxygen resource. Excessive deoxygenation can result because of the high biological oxygen demand.

The streams so affected by acid mine drainage that the 1983 water quality criteria could not be met regardless of the treatment level of other wastewater effluents, were classified "acid mine drainage affected" by DER. The streams receiving the acid mine drainage mostly from abandoned mines which will prevent attaining water quality standards even with perfect control of all point sources, were placed in Category III. The streams affected by acid mine drainage and their classification (Class and Category) are listed in Table 2.1.6.-14 for the Monongahela River Basin, in Table 2.1.6.-23 for the Allegheny River Basin, and in Table 2.1.6.-32 for the Ohio River Mainstem Basin. The standards for pH and total iron are often exceeded in these streams and concentrations of calcium, magnesium, sulfate, manganese, aluminum, and other trace elements are high (see Tables 2.1.6.-15, 2.1.6.-24, and 2.1.6.-33 for the same three river basins, respectively).

Until recently the Monongahela River was severely degraded by acid mine drainage. The mainstem was acidic from the head of the river at Fairmont, West Virginia, to the mouth at Pittsburgh, Pennsylvania. In the last few years there has been substantial progress in the abatement programs and pH related problems have been reduced considerably. During the summer of 1975 an intermediate-flow survey conducted by the Army Corps of Engineers (23), showed that the pH of the mainstream ranged from 6.5-7.5. The low flow survey showed a range of pH 3.8-8.0. Figure 2.1.6.-41 depicts the variation in pH with mileage along the Monongahela River in the Summer of 1973. The problem area lies between Maxwell Dam (River Mile 65) and Lock and Dam #8 (River Mile 95). Hatfield Power Plant is located in this reach at River Mile 78. Mines in the Morgantown area will, at times, cause pH depressions and this is evident at Lock and Dam #8. The most abrupt pH depression occurs immediately downstream of the mouth of the Cheat River. When the flow at Dam #8 is low (less than 1,000 cubic feet per sec.), there is little water available for the dilution and neutralization of the acid Cheat River water. Acid is discharged from Lake Lynn, a private hydroelectric power station of 19 megawatts peak capacity, located several miles upstream of the mouth of the Cheat. Because travel time below the mouth is relatively slow during low flow, the acid discharges from Lake Lynn are retained and concentrated in this reach. Figure 2.1.6.-40 shows the location of this area which is just north of the Pennsylvania-West Virginia state line.

The following list and discussion of streams affected by acid mine drainage is taken from the COWAMP Reports (1) and (2). The limits mentioned are those set for desirable stream quality; i.e. total iron concentrations less than 1.5 mg/l and pH 6 to 8.5.

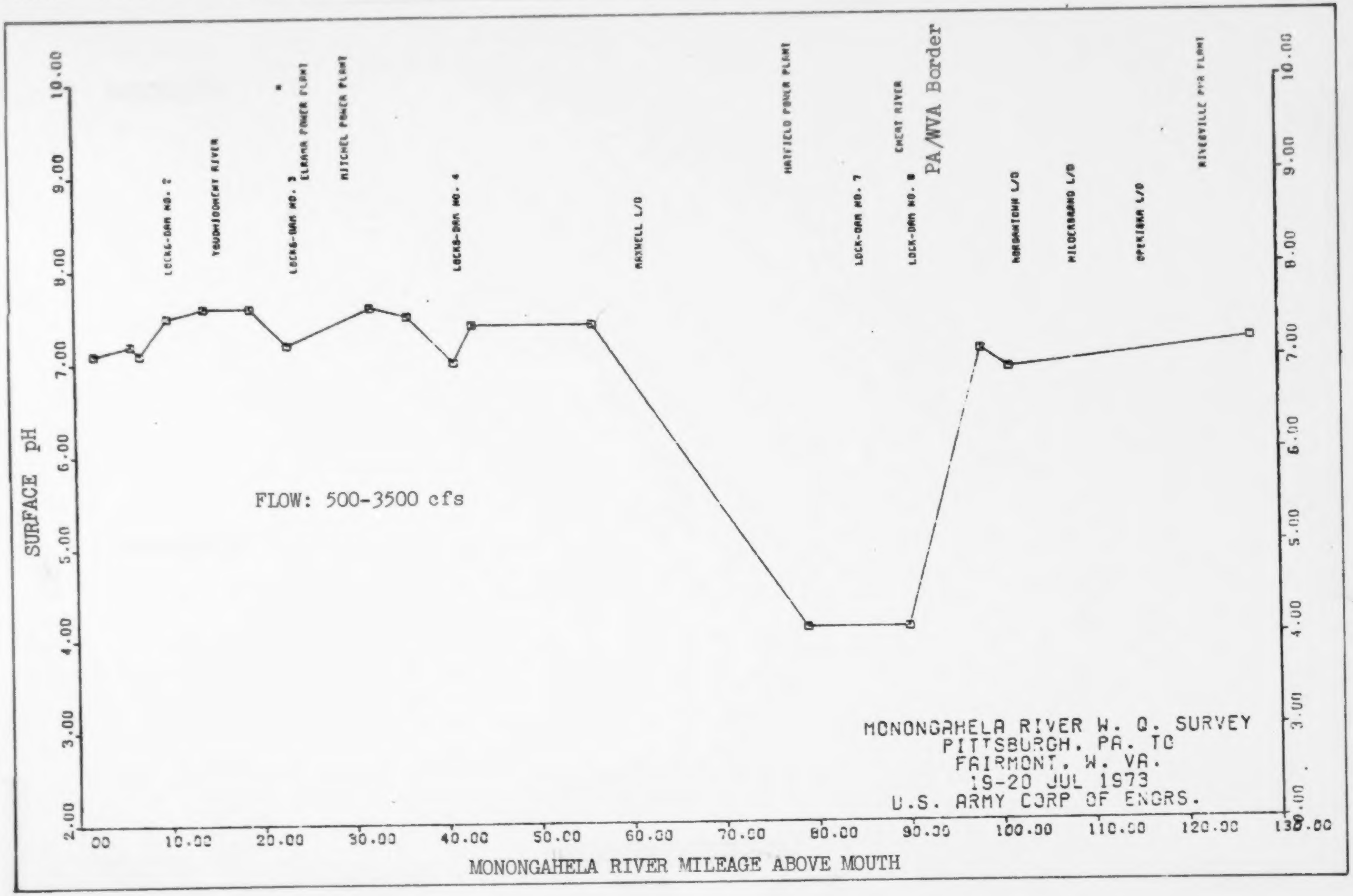
COWAMP AREA #9

Allegheny County

Tributary of Bull Creek, 18A - incidents of mine drainage pollution as a result of malfunctioning treatment systems.
Turtle Creek, 19A - severely depressed throughout by mine drainage, essentially dead.
Thompson Run, 19A.
Youghiogheny River, 19D.

FIGURE 2.1.6.-41 VARIATION IN pH ALONG THE MONONGAHELA RIVER IN 1973

Source (23)



Peters Creek and Tributaries, 19C - marginally affected; four of 13 samples over a 900-day period (1972-1975) were above the maximum limit for total iron; pH remained within limits for this same period.

Chartiers Creek and Tributaries, 20F - severely depressed by acid mine drainage; since before 1955 total iron concentrations have been consistently above the maximum limit; 19 of 40 samples taken from 1962 to 1971 were below the minimum pH limit; all 8 samples from 1971 to 1975 were within limits.

Montour Run and Tributaries, 20G.

Deer Creek, 18A - over an 800-day period (1972-1974) total iron concentrations and pH were within limits.

Plum Creek and Tributaries, 18A - moderately to severely depressed by acid mine drainage.

Perry Mill Run, 19C.

Pine Creek,18A - depressed downstream from Wildwood Mine; incidents of mine drainage pollution as a result of malfunctioning treatment systems; 8 of 15 samples taken over an 800-day period (1972-1974) were above the total iron concentration limit; however, pH was always within limits.

Allegheny River, 18A - marginally affected; total iron concentration frequently rose above the limit from 1955 through 1974; pH fell below the limit on occasion from 1962 through 1973.

Monongahela River, 19A and 19C - marginally affected; from 1955 through 1974 total iron concentration was above the limit and pH below the limit frequently.

Armstrong County

Tributary Mudlick Creek, 19D - incidents of mine drainage pollution as a result of malfunctioning treatment system.

Crooked Creek and Reservoir, 17E - severe acid mine drainage pollution at mouth; incidents of mine drainage pollution as a result of malfunctioning treatment system; total iron concentrations were frequently above the limits from 1958 through 1971; from 1971 through 1975 total iron concentrations were within or nearly within limits; pH was on most occasions from 1963 through 1970 below the minimum limit; however, from 1970 through 1975, pH has remained within limits.

Kiskiminetas River, 18B - severe AMD pollution at mouth; from 1955 to 1975 total iron concentrations have been above the limit on all but three occasions; from 1963 to 1975, pH has been below the limit on all but one occasion.

Long Run and Tributaries, 18B.

Big Run and Tributaries, 18C - incidents of mine drainage pollution as a result of malfunctioning treatment system.

Guffy Run and Tributaries, 18B.

Mahoning Creek, 17D - severe AMD pollution at mouth; incidents of mine drainage pollution as a result of malfunctioning treatment. system; total iron concentrations and pH have been within limits on most occasions in other sections.

Pine Run and Tributaries, 17D.

Glade Run and Tributaries, 17D.

Cowanshannock Creek, 17E - somewhat depressed in headwaters by AMD; recovered at mouth; from 1972 through 1975, total iron concentrations exceeded limits in only 2 of 14 samples; pH remained within limits during this period.
Tributary of Roaring Run, 18B - incidents of mine drainage pollution as a result of malfunctioning treatment system.
Tributary of Allegheny River, 17D - incidents of mine drainage pollution as a result of malfunctioning treatment system.
Redbank Creek, 17C and 17D - depressed by AMD near mouth; incidents of mine drainage pollution as a result of malfunctioning treatment system.
Buffalo Creek, 18F - depressed by AMD in headwaters, good to excellent remainder of length; incidents of mine drainage pollution as a result of malfunctioning treatment system; total iron and pH limits were infrequently exceeded from 1962 to 1975.
Tributary of Allegheny River, 17C - incidents of mine drainage pollution as a result of malfunctioning treatment systems.
Tributary of Allegheny River, 17E - incidents of mine drainage pollution as a result of 2 malfunctioning treatment systems.
Tributaries to Scrubgrass Creek, 17D - incidents of mine drainage pollution as a result of malfunctioning treatment system.
Limestone Run, 17E - incidents of mine drainage pollution as a result of malfunctioning treatment system.
Garret Run, 17E - incidents of mine drainage pollution as a result of malfunctioning treatment system.
Whiskey Run, 18C - incidents of mine drainage pollution as a result of malfunctioning treatment system.

Beaver County

Raccoon Creek, 20D - total iron concentrations from 1955 through 1974 have, on most occasions, been above the limit; pH from 1962 through 1974 has most often been below the limit; however, all samples since mid-1972 through 1974 have been within limits.
Tributary Brush Run, 20B - incidents of mine drainage pollution as a result of malfunctioning treatment system.

Butler County

North Slippery Rock Creek and Tributaries, 20C - 1972 through 1974 pH remained within limits; total iron limit was exceeded once in mid-1973.
Bear Creek, 17C - severely depressed downstream from abandoned strip mines.
Yellow Creek, 20C - severely depressed by AMD.
Tributary of Yellow Creek, 20C - fair stream conditions indicated.
Tributaries Allegheny River, 17C - incidents of mine drainage pollution as a result of malfunctioning treatment system.
Tributary Mulligan Run, 20C - incidents of mine drainage pollution as a result of malfunctioning treatment system.

Fayette County

Jacobs Creek, 19D.
Indian Creek, 19E.
Champion Creek and Tributaries, 19E.
Stony Run and Tributaries, 19E.
Poplar Run and Tributaries, 19E.
Monongahela River, 19C and 19G - marginally affected; from 1962 through 1973 total iron concentrations and pH were rarely within limits.
Youghiogheny River, 19C and 19G - marginally affected; from 1962 through 1974 total iron concentrations and pH rarely beyond limits.
Galley Creek, 19C.
Redstone Creek, 19C - total iron concentrations from 1964 to 1975 have been above the maximum limit; pH rarely below the minimum.
Bolden Run and Tributaries, 19C.
Bute Run and Tributaries, 19C.
Rankin Run and Tributaries, 19C.
Browns Run and Tributaries, 19C.
Jacobs Creek and Tributaries, 19G.
Cats Creek and Tributaries, 19G.
York Run, 19G - severely depressed by AMD from strip mining.
Georges Creek, 19G - severely depressed by strip mine runoff from York Run
Little Sandy Creek, 19G - headwater drainage of poor quality due to mine drainage.
Dunlap Creek, 19C - some mine drainage problems; conditions improving.
Ferguson Creek, 19D - incidents of mine drainage pollution as a result of malfunctioning treatment system.

Greene County

Dunkard Creek, 19G - depressed downstream by mine drainage; incidents of mine drainage pollution as a result of malfunctioning treatment system; all samples taken from 1955 through 1974 had total iron concentrations equal to or greater than the limit; from 1963 to 1971 pH was most frequently below limit; 1971 through 1974 produced samples within the limits for pH.
Whiteley Creek, 19G - incidents of mine drainage pollutions as a result of malfunctioning treatment system.
Tributary Witley Creek, 19G - very good quality; Buckeye Coal Company discharge showed no permanent damage.
Muddy Creek, 19B - slightly depressed upstream by intermittent mine drainage from Buckeye Coal Company; incidents of mine drainage pollution of malfunctioning treatment system.

Indiana County

North Branch Two Lick Creek and Tributaries, 18D.
South Branch Two Lick Creek and Tributaries, 18D.
Dixon Run and Tributaries, 18D.
Two Lick Creek, 18D - 1962 through 1974 samples were rarely within

limits for total iron concentration and pH; total iron above the maximum and pH below the minimum.
Penn Run and Tributaries, 18D.
Two Lick Creek Reservoir, 18D.
Yellow Creek and Tributaries, 18D - productivity is very low; several tributaries are severely polluted with mine drainage.
Blacklick Creek, 18D - 1962 to 1975, all samples had pH below minimum limit; 1955 to 1975 total iron concentration was above maximum limit.
Stevens Run, 18D - incidents of mine drainage pollution as a result of malfunctioning treatment system.
Carney Run, 18D - incidents of mine drainage pollution as a result of malfunctioning treatment system.
Brush Creek Tributaries, 18D.
Ahltman Run and Tributaries, 18D.
Whiskey Run and Tributaries, 18C.
Big Run and Tributaries, 18C.
Richards Run and Tributaries, 18D.
Tributary Crooked Creek 17E - incidents of mine drainage pollution as a result of malfunctioning treatment system.
Tributary Blacklegs Creek, 18C - incidents of mine drainage pollution as a result of malfunctioning treatment system.
Hicks Run, 18D - incidents of mine drainage pollution as a result of malfunctioning treatment system.

Washington County

Harmon Creek and Tributaries, 20D - severely depressed due to mine drainage, especially aluminum; slight recovery in lowest reaches.
North Forks Cross Creek and Tributaries, 20D.
Cross Creek and Tributaries, 20D.
Raccoon Creek, 20D.
Burgetts Fork, 20D.
Chartiers Run, 20F.
Chartiers Creek, 20F - severely depressed by AMD; incidents of mine drainage pollution as a result of malfunctioning treatment system; from 1972 through 1974, pH has remained within limits, total iron concentration has risen above the limit on occasion.
Peters Creek, 19C - marginally affected.
Maple Creek and Tributaries, 19C.
Pigeon Creek, 19C - marginally affected; incidents of mine drainage pollution as a result of malfunctioning treatment system; from 1972 through 1974, total iron concentration has risen above the limit on occasion; pH has remained within limits; excessive amounts of manganese.
Brush Run, 20F - incidents of mine drainage pollution as a result of malfunctioning treatment system.

Westmoreland County

Beaver Run, 18B.
Walford Run and Tributaries, 18B.
Getty Run and Tributaries, 18C.

Loyalhanna River and Reservoir, 18C - severely depressed in downstream zones; from 1962 to 1975, total iron concentration and pH have rarely been within limits.

Crabtree Creek and Tributaries, 18C - incidents of mine drainage pollution as a result of malfunctioning treatment system

Union Run and Tributaries, 18C.

Saxman Run and Tributaries, 18C.

Jamison Reservoir and Tributaries, 18C.

Brush Creek, 19A.

Turtle Creek, 19A - severely depressed throughout by mine drainage; essentially dead.

Sewickley Creek, 19D - several sources of mine drainage eliminate most aquatic life; from 1963 through 1974 on all but one occasion, total iron concentration above the maximum limit; pH frequently below the lower limit.

Barren Run, 19D.

Meadow Run, 19D.

Stauffer Run, 19D.

Sherrick Run, 19D.

Youghiogheny River, 19D - marginally acid downstream from confluence with Casselman River; incidents of mine drainage pollution as a result of malfunctioning treatment system; from 1955 through 1974, total iron concentration remained below maximum limit; from 1962 to mid-1969, pH below the minimum limit frequently; from mid-1969 through 1973, pH has remained within limits.

COWAMP AREA #8

In Clarion County 12 malfunctioning surface mine drainage treatment facilities have caused pollution in nine streams: Long Run and Jacks Run (17C) in Porter Township, tributary to Curtly Run (17B) in Beaver Township, tributary to Cherry Run (17B) in Toby Township, Piney Creek (17B) in Limestone Township, Bausch Run (17B) in Monroe Township, unnamed run to Deer Creek (17B) in Elk Township, tributary to Toby Creek (17B) in Highland Township, Little Licking Creek (17B) in Limestone Township, and an unnamed tributary to Anderson Run and Licking Creek (17B) in Licking and Perry Townships.

Two streams in Elk County, Beaver Run (17A) and an unnamed tributary to Little Toby Creek (17A), both in Fox Township, have been polluted by malfunctioning surface mine drainage treatment facilities. There was one similar problem in Venango County on the East Branch Wolf Creek (20C) in Irwin Township. No other counties indicated problems resulting from either surface or deep mine drainage treatment facilities.

Non-point source AMD occurs in Mill Creek (17A), Toby Creek (17A), Deer Creek (17B), Paint Creek (17B), Little Piney Creek (17B), Licking Creek and its tributaries (17B), Little Licking Creek (17B), and the main stream of the Clarion River (17B) at its confluence with Toby Creek (17A) approximately one mile from its mouth, discharging into Piney Dam (17A).

On the Clarion River only Station 825 just above Glen Hazel had a consistently low pH, generally between pH 4 to 6 prior to 1971 and only once thereafter, in 1974. Other stations (821, 822, 823, 824, 833, and 843) occasionally had pH's below 6.0 and total iron concentrations greater than 1.5 mg/l.

East Sandy Creek (16G) is polluted at its headwater area by acid mine drainage; several Scarlift projects are underway in this area. Mahoning Creek (17D) also is affected by severe acid mine drainage at its mouth. In the Bear Creek Basin (17C), the north branch is affected by drainage from extensive strip mining. Fiddlers Run (17C), Leisure Run (17C), Town Run (17C), Welch Run (17C), Runaway Run (17C), and Redbank Creek (17C) show evidence of acid mine drainage pollution. Several Operation Scarlift projects also are in operation in this area.

High sedimentation problems and correspondingly high total dissolved solids (TDS) values probably can be found in acid mine drainage problem areas. Slippery Rock Creek (20C) in the area of McConnell's Mills State Park has sedimentation problems and high dissolved solids values due to active open pit limestone mining in the surrounding area and strip and deep mine activity.

Abatement programs are designed to prevent the initial formation of sulfuric acid, backed up by treatment facilities and river flow regulation.

All active mines have been required to treat acid drainage since 1965. In 1975, there were 105 deep mine drainage treatment facilities in the PA ORBES Region. These are summarized in Table 2.1.6.-54 according to activity status for each county. The estimated total actual flow treated is also given.

There were over 700 facilities in existence for surface mine drainage treatment. Their numbers in each county and activity status are given in Table 2.1.6.-55.

More details of the treatment plants (both for deep and surface mine drainage), effluents, and effects on the receiving stream water quality are available in the COWAMP Study Reports (1), (2), (3), (4).

The effluent from active mine drainage treatment facilities comprises the smaller portion of the mine drainage reaching the surface waters in the area. The drainage from only a few abandoned mines receives direct treatment, the majority reaches the surface waters without any treatment at all. (Actually,

TABLE 2.1.6.-54

DEEP MINE DRAINAGE TREATMENT SUMMARY IN THE PA. ORBES REGION AS OF 1975

Sources (1), (2), (3), (4)

County	No. of Active Facilities	No. of Inactive Facilities	No. of Completed Facilities	No. of Facilities Not Started	Total No. of Facilities	Total Actual Flow (mgd)
Allegheny	5	0	0	0	5	6.0
Armstrong	9	1	1	1	12	5.3
Beaver	1	0	0	0	1	0.04*
Butler	1	0	0	2	3	3.3
Cambria	13	0	0	0	13	
Clarion	0	1	0	0	1	0.0005
Clearfield	5	0	0	0	5	
Elk	1	0	0	0	1	Var.
Fayette	2	0	0	0	2	5.1
Greene	8	0	0	0	8	6.6
Indiana	12	2	2	2	18	3.5
Jefferson	0	1	1	0	2	0.001
Somerset	14	0	0	0	14	
Washington	14	0	1	0	15	11.7
Westmoreland	4	1	0	0	5	16.7
Totals	89	6	5	5	105	58.2+

*Design flow used.

TABLE 2.1.6.-55

SURFACE MINE DRAINAGE TREATMENT SUMMARY IN THE PA ORBES REGION AS OF 1975*

Sources (1), (2), (4)

County	No. of Active Facilities	No. of Inactive Facilities	No. of Completed Facilities	Total No. of Facilities
Allegheny	10	3	0	13
Armstrong	75	14	5	94
Bever	9	0	0	9
Butler	19**	0	0	19
Clarion	124	1	6	131
Clearfield	129	0	0	129
Elk	21	0	2	23
Fayette	61	0	1	62
Greene	6	0	0	6
Indiana	49	0	0	49
Jefferson	53	0	1	54
Lawrence	14	2	0	16
Mercer	3	3	0	6
Venango	14	0	0	14
Washington	28	0	0	28
Westmoreland	47	0	0	47
Totals	662	23	15	700

*Cambridge and Somerset Counties not included.

**Includes two facilities of uncertain status.

deep mines abandoned before 1966 have not been included in the COWAMP inventory due to lack of data.) However, if mining is to be initiated in the area of an abandoned mine, the company must assume the responsibility for treatment of the discharge from the old mine.

Current iron and acid loads in the streams of the Upper Ohio Basin are listed in Table 2.1.6.-56. Also given is the type of mine (active or abandoned) responsible for the loads. The predominant number of sources are either abandoned mines or marginal cases where it is not known whether the source is active or inactive. The Table is based entirely on a literature review of available data and does not represent a comprehensive listing (1), (2).

Responsibility for abatement of acid mine drainage from former operations has been taken up by the Pennsylvania Department of Environmental Resources (D.E.R.). This is because the original mine operator cannot legally be held responsible for acid mine drainages that now emanate from abandoned sites. The program adopted by D.E.R. in 1967 consisted of four stages (18):

Phase I: Source Inventory.

Field crews located and mapped the sources of pollution from abandoned mines.

Phase II: Engineering Studies and Plans.

Feasibility studies were undertaken and engineering plans for abatement were drawn up.

Phase III: Construction.

- Sealing of deep mines
- Burial of exposed acid-forming refuse.
- Backfilling pre-act strip pits
- Correction of defective backfills
- Diversion of streams and rainfall run-off seeping into mines

TABLE 2.1.6.-56 ACIDITY AND IRON LOADS IN THE STREAMS OF WESTERN PENNSYLVANIA After Sources (1), (2)

Stream	No. of Sources				Average Annual Discharge (gpm)	Total Acidity Load (lbs/day)	Total Iron Load (lbs/day)
	Mines			Other			
	Active	Unknown	Inactive				
Allegheny River Basin							
Redbank Creek*		2		2	102	327	152
Mahoning Creek		38			5,500	2,036	1,226
Big Scrubgrass Creek		31			3,165	7,167	220
Clarion River							
Toby Creek (Clarion County)			68	14	2,090	81,005	6,558
Piney Creek	3		70	6	1,623	10,941	678
Mill Creek			15	6	423	6,947	611
Licking Creek	1		141	1	1,095	6,314	673
Toby Creek (Elk and Jefferson Counties)	3		118	1	10,164	37,408	2,311
Deer Creek			43	16	1,403	10,842	2,119
East Branch Clarion River		33				5,568	186
Cowanshannock Creek						8,789	1,380
Kiskiminetas River	2		78	9	4,439	57,880	8,802
Conemaugh River	1		29	6	3,045	35,104	11,587
Blacklick Creek	14		125	22	25,196	273,196	58,174
Twolick Creek	7		143	24	7,102	36,645	4,023
Loyalhanna Creek		47		5	11,165	65,407	26,090
Monongahela River Basin							
Lower Monongahela		232				12,400	9,069
Middle Monongahela		125				50,400	16,428
Upper Monongahela**		195				233,453	64,844
Redstone and Dunlap Creeks		20				21,203	18,352
Tenmile Creek		53				838	2,094
Dunkard Creek**		30				10,994	4,506
Big Sandy Creek**		42				1,496	160

TABLE 2.1.6.-56 (Continued)

Stream	No. of Sources				Average Annual Discharge (gpm)	Total Acidity Load (lbs/day)	Total Iron Load (lbs/day)
	Mines			Other			
	Active	Unknown	Inactive				
Monongahela River Basin (Cont.)							
Youghiogheny River	1		14		13,653	26,200	12,720
Sewickley Creek	2		12		14,326	73,780	19,610
Jacobs Creek			2		42	810	140
Indian Creek			7		944	13,510	1,230
Ohio River Mainstem Basin							
Beaver River							
Slippery Rock Creek		83		4	7,326	8,073	528
Chartiers Creek		4			2,657	4,868	1,728
Robinson Run		17			1,506	8,381	3,437
N. Br. Robinson Run		16			1,328	9,099	372
Millers Run		2			1,552	9,764	1,294
Saw Mill Run		4					
Raccoon Creek		3					
Unnamed Tributaries		30			1,698	22,648	1,355
Burgetts Fork		14			1,616	21,674	3,947
Little Raccoon Run		25			463	7,307	382
St. Patrick Run		12			488	5,681	432
Brush Run		6			281	3,620	24
Chamberlain Run		3			125	1,007	11
Dilloe Run		1			120	2,988	42
Bigger Run		7			633	9,258	817
Potato Garden Run		31			373	10,190	1,633

*Available unpublished information includes only major pollution sources in the Welch Run Watershed.

**Portions of basins in West Virginia are included.

- Regulation of stream flows by low flow augmentation
- Treatment

Phase IV: Operation and maintenance of abatement facilities such as treatment plants, mine seals and flow regulation dams.

When "Operation Scarlift" became operational in 1968, numerous specific projects were undertaken because of the huge increase in funds available. Table 2.1.6.-57 lists the number of projects in the ORBES Pennsylvania counties, both completed and current, as of December 1975.

Approximately $76 million of the ten-year allotment for abandoned mine projects ($150 million) had been encumbered as of December 1975 and $50 million had been actually disbursed over the State. A detailed listing of project locations and descriptions is given in the Appendices to Chapter VI of the COWAMP Reports for Study Areas #8 and #9 (1), (2).

Sludge generated by acid mine drainage treatment is handled in a variety of ways. The volume generated is very large and contains from 1 - 5% dry solids by weight (53). Systems either currently in use, or proposed, for dewatering and disposal of sludge include (53): lagoons, landfill, abandoned deep mines, air drying, porous drying beds, and vacuum filtration.

Details concerning the sludge generated from each mine drainage facility in western Pennsylvania counties is presented in COWAMP Reports (1)& (2). The estimated sludge volumes are summarized in Table 2.1.6.-58.

TABLE 2.1.6.-57

NUMBER OF OPERATION SCARLIFT PROJECTS IN WESTERN PENNSYLVANIA COUNTIES

(As of December 1975)

Sources (1), (2), (3)

County	Completed Projects	Current Projects	Total Projects
Allegheny	20	19	39
Armstrong	2	1	3
Beaver	1	2	3
Butler	24	22	46
Cambria	10	2	12
Clarion	6	19	25
Clearfield			
Elk	9	18	27
Fayette	7	8	15
Indiana	14	16	30
Jefferson	4	2	6
Lawrence	1	0	1
Mercer	3	1	4
Somerset	5	4	9
Venango	5	10	15
Washington	15	18	33
Westmoreland	11	10	21
Totals	137	152	289

TABLE 2.1.6.-58

ACID MINE DRAINAGE SLUDGE PRODUCTION SUMMARY

Sources (1), (2)

County	Total Wet Sludge Produced (tons/day)		Total Dry Sludge Produced (tons/day)	
	Deep	Surface*	Deep	Surface*
Allegheny	1,480	3	130	0.1
Armstrong	3,340	450	90	12.2
Beaver	-	-	-	-
Butler	2,710	-	70	-
Clarion	0.4	2.5	0.01	0.06
Elk	-	4.8	-	0.15
Fayette	130	50	110	1.5
Greene	5,430	-	140	-
Indiana	1,500	3	75	0.1
Jefferson	0.8	116.8	-	2.74
Washington	8,230	-	230	-
Westmoreland	8,890	-	350	-
Totals	31,711.2	630.1	1,200	15.35

*Many data gaps exist.

REFERENCES

1. Green International, Inc.: "Comprehensive Water Quality Management Plan, Upper Allegheny River Basin, Study Area 8;" Preliminary Draft prepared for the Commonwealth of Pennsylvania, Department of Environmental Resources, Sewickley, PA, 1976.

2. Green International, Inc.: "Comprehensive Water Quality Management Plan, Ohio Valley Study Area, Study Area 9;" Preliminary Draft prepared for the Commonwealth of Pennsylvania, Department of Environmental Resources, Sewickley, PA, 1976.

3. Gilbert Associates, Inc.: "Comprehensive Water Quality Management Plan, COWAMP Study Area 5;" Preliminary Draft prepared for the Commonwealth of Pennsylvania, Department of Environmental Resources, Reading, PA, 1975.

4. Gannett Fleming Corddry and Carpenter, Inc.: "Comprehensive Water Quality Management Plan, Central Susquehanna River Basin, Study Area 6;" Preliminary Draft prepared for the Commonwealth of Pennsylvania, Department of Environmental Resources, Harrisburg, PA, 1976.

5. Commonwealth of Pennsylvania, Department of Environmental Resources: "Pennsylvania Water Quality Network - Sampling Station Description;" Publication No. 33, 1975.

6. ORSANCO: Robot Monitor Computer Printouts; Cincinnati, Ohio.

7. ORSANCO: "Quality Monitor;" Cincinnati, Ohio.

8. National Commission on Water Quality: Staff Draft Report; Washington, D. C., November 1975.

9. U. S. Department of the Interior, Heritage Conservation and Recreational Service, Northeast Regional Office: "Youghiogheny River - A Wild and Scenic Rivers Study, Maryland - Pennsylvania;" Draft Report, May 1978.

10. U. S. Environmental Protection Agency, Philadelphia, PA, and PA Department of Environmental Resources, Harrisburg, PA: "Water Quality Standards Summary for Interstate Waters in the Commonwealth of Pennsylvania;" Document No. 42-001, 1972.

11. Commonwealth of Pennsylvania, Legislative Reference Bureau: "Pennsylvania Bulletin," Volume 8, No. 9; Harrisburg, PA, March 4, 1978.

12. Commonwealth of Pennsylvania: "Pennsylvania Code;" Title 25 - Rules and Regulations, Part I - Department of Environmental Resources, Subpart C - Protection of Natural Resources, Article II - Water Resources; Harrisburg, PA.

13. Pennsylvania Department of Environmental Resources: "Pennsylvania Scenic Rivers Inventory;" Harrisburg, PA, July 1975.

14. Durfor, C. N. and P. W. Anderson: "Chemical Quality of Surface Waters in Pennsylvania;" U.S.G.S., Water Supply Paper 1619-W, 1962.

15. Whetstone, G. W.: "Statement on Water Resources Investigations in the Monongahela River Basin;" Conference in the Matter of Pollution of the Interstate Waters of the Monongahela River and Its Tributaries, Pittsburgh, PA, December 17, 1963.

16. Sidio, A. D. and K. M. Mackenthun: "Report on Pollution of the Interstate Waters of the Monongahela River System;" R. A. Taft Sanitary Engineering Center, Cincinnati, Ohio, December 1963.

17. Shapiro, M. A., J. B. Andelman, P. V. Morgan: "Intensive Study of the Water at Critical Points on the Monongahela, Allegheny and Ohio Rivers in the Pittsburgh, Pennsylvania Area;" Dept. of Public Health Practice, GSPH, Univ. of Pittsburgh, Pittsburgh, PA, 1965.

18. PA Department of Environmental Resources, Bureau of Sanitary Engineering: "Water Quality Management in the Monongahela River Basin;" Publication No. 29, August 1971.

19. U. S. Environmental Protection Agency, Region III: "A Report on the Pollution of the Ohio River and Its Tributaries in the Pittsburgh, Pennsylvania Area;" Philadelphia, PA 1971.

20. Preston, H. R.: "Monongahela River Basin Aquatic Biology, Part I: Fish Population Studies of the Monongahela River;" U.S.E.P.A., Wheeling Field Office, Wheeling, W.Va., October 1974.

21. Ohio River Basin Commission: "Level B Report for the Monongahela River Basin;" Comprehensive Coordinated Joint Plan (draft copy), Cincinnati, Ohio, 1974.

22. U. S. Army Corps of Engineers: "Monongahela River - Pennsylvania and West Virginia, Draft Environmental Statement on the Operation and Maintenance of the Navigation System;" Pittsburgh District, Pittsburgh, PA, June 1975.

23. U. S. Army Corps of Engineers: "Monongahela River Navigation Projects - Annual Water Quality Report 1976;" Pittsburgh District, Pittsburgh, PA, February 1976.

24. U. S. Army Corps of Engineers: "Youghiogheny River Lake Water Quality Report;" Pittsburgh District, Pittsburgh, PA, June 1978.

25. PA Department of Environmental Resources, Bureau of Water Quality Management: "Commonwealth of Pennsylvania - 1978 Water Quality Inventory;" Publication No. 42, Harrisburg, PA, April 1978.

26. Southwestern Pennsylvania Regional Planning Commission: "208/COWAMP Progress Report - Water Quality Management Planning in Southwestern Pennsylvania;" Pittsburgh, PA, June 1976.

27. PA Department of Environmental Resources: "Sub-Basin 16 & 14," "Sub-Basin 17," "Sub-Basin 18," "Sub-Basin 19," "Sub-Basin 20;" State Water Plan (Draft Copy); Harrisburg, PA, August 1977.

28. Commonwealth of Pennsylvania: "Pennsylvania Water Quality Criteria;" Pennsylvania Code, Title 25 - Rules and Regulations, Part I - Environmental Resources, Chapter 93, Adopted September 2, 1971, Amended through June 20, 1974, Effective July 14, 1974.

29. Southwestern Pennsylvania Regional Planning Commission. "Plans and Choices - Water Quality Management for the Southwestern Pennsylvania Region;" Report prepared for the PA Department of Environmental Resources, October 1978.

30. Love, S.K.: "Quality of Water in the Upper Ohio River Basin;" in: "Man and the Waters of the Upper Ohio Basin - A Symposium;" Pymatuming Laboratory of Field Biology; Special Publication No. 1, February 1956.

31. Reilly, Thomas L.: "Allegheny Reservoir's Role in Water Quality;" Journal American Water Works Association, Vol. 61, No. 5, May 1969.

32. U. S. Army Corps of Engineers: "Water Quality Reservoirs;" Pittsburgh District, Pittsburgh, PA, November 1969.

33. U. S. Army Corps of Engineers: "Annual Water Quality Report - East Branch Clarion River Project, 1975;" Pittsburgh District, Pittsburgh, PA, July 1975.

34. U. S. Army Corps of Engineers: "Allegheny River, Pennsylvania (Mile 0 to Mile 72) - Final Environmental Statement on the Operation and Maintenance of the Navigation System;" Pittsburgh District, Pittsburgh, PA, October 1975.

35. PA Department of Environmental Resources, Bureau of Water Quality Management: "Report to the PA Environmental Quality Board on Recommended Revisions to Water Quality Criteria" (Comment Draft, prepared for the 1976-77 Water Quality Standards Review); Harrisburg, PA, May 25, 1977.

36. U. S. Department of Interior, Federal Water Pollution Control Administration: "Framework Study of Water Supply and Water Pollution Control Problem Areas in the Ohio River Basin;" Ohio River Basin Comprehensive Survey, Volume V, Appendix D, U. S. Army Engineer Division, Ohio River - Cincinnati, Ohio, June 1967.

37. Ohio River Valley Water Sanitation Commission: "Assessment of Water Quality for the Ohio River Main Stem;" (Draft), Prepared for The Ohio River Basin Commission's Ohio River Main Stem Water and Related Land Resources Study, Cincinnati, Ohio, March 1977.

38. U. S. Army Corps of Engineers: "An Evaluation of the effects of Main Stem Navigation Dams on the Water Quality of the Upper Ohio River;" Army Engineer District, Pittsburgh, PA, June 1975.

39. Ohio River Valley Water Sanitation Commission: "Ohio River Main Stem - Assessment of 1977 and Future Water Quality Conditions;" prepared for inclusion in 1978 State Water Quality Reports to the Administrator, U.S.E.P.A., March 1978.

40. Commonwealth of Pennsylvania, Legislative Reference Bureau: "Pennsylvania Bulletin;" Volume 7, No. 10, Harrisburg, PA, March 5, 1977.

41. R.D. Hill and R.C. Wilmoth: "Limestone Treatment of Acid Mine Drainage;" Transactions, Vol. 250: pp. 162-166, June 1971, E.P.A. 14010 -- 10/70.

42. H.F. Grubb and P.D. Ryder, "Effects of Coal Mining on the Water Resources of the Tradewater River Basin, Kentucky." Geological Survey Water-Supply Paper 1940, U.S. Dept. of the Interior, Washington, D.C. 1972.

43. "Development Document for Interim Final Effluent Limitations Guidelines and New Point Source Performance Standards for Coal Mining Point Source Category." EPA 440/1-75/057, Washington, D.C. October 1975. in "Acid Mine Drainage Program (Draft)." Green International Inc., Sewickley, PA, April 1977.

44. C. Boyer, Bituminous Coal Research Inc. Monroeville, PA (personal communication) March 1978.

45. R. Zahradnik, "Coal: The Burning Question." in Panel at Conference held by League of Women Voters of Pennsylvania. Carnegie Mellon Institute of Research, March 10, 1978.

46. C.A. Berg, "Process Innovation and Change in Industrial Energy Use." Science: Vol. 199, No. 4329, pp. 608-614, Feb. 1978.

47. U.S. Army Corps of Engineers; Ohio River Committee. "Ohio River Pollution Control." 78th Congress, 1st Session --- House Document, No. 266, Washington, D.C. 1944.

48. J.P. Hartnett, "Development of Baseline Data for the Ohio River Basin Energy Study." Environmental Protection Agency, Washington, D.C. June 1977.

49. J.P. Hartnett, "A Preliminary Report prepared for the Ohio River Basin Energy Study." University of Illinois at Chicago Circle, April 1978.

50. A.L. Hammond, "An Interim Look at Energy" Science: Vol. 199, No. 4329, p. 607, Feb. 1978.

51. E.F. McCarren, "Chemical Quality of Surface Water in the Allegheny River Basin Pennsylvania and New York." U.S. Dept. of the Interior, Geological Survey Water-Supply Paper 1835, Washington, D.C. 1967.

52. Ohio River Valley Sanitation Commission, Fifteenth Annual Report. Cincinnati, Ohio 1963.

53. Skelly and Loy Consultants, Penn Environmental Consultants, "Processes, Procedures, and Methods to Control Pollution from Mining Activities." Environmental Protection Agency, Washington, D.C., EPA-430/73-011, Oct. 1973.

2.1.7. AQUATIC ECOLOGY

2.1.7.1. GENERAL OVERVIEW

A. Historical Background

Any retrospective characterization of the aquatic ecology of the Pennsylvania ORBES region to colonial times must rely heavily upon scattered historical documents that make reference to fish fauna. A review of such documents has led Lachner (1) to conclude that "...the fish heritage in the Upper Ohio Basin was extremely rich. Dense schools of fish existed in these waters. Early explorers and pioneers traversing the Alleghenies found the streams teeming with life and these provided them with a ready source of excellent food." The seventeen species listed by Lachner (Table 2.1.7.-1), although not all suitable as table fare, were reported as occurring in the Upper Ohio Basin prior to 1900. Many of these species probably never were exceedingly numerous in the basin. Others were reported as being common to abundant in colonial times. About one-third of these seventeen species still inhabit that portion of the basin in Pennsylvania. Nonetheless, Lachner notes of this list that "...the general data warrant the thesis that there has been a great reduction in numbers and the extirpation of many forms." Indeed, many of the species currently categorized by the Pennsylvania Fish Commission as "endangered," "threatened," or "status indeterminate" (see Table 2.1.7.-2) were once inhabitants of the Ohio River Basin. Habitat preferences for most basin fishes are outlined in Appendix A.

B. Past Impacts

Relatively little eighteen and nineteenth century information exists that would help characterize the plankton, periphyton, and macrobenthos of western Pennsylvania waterways. It has been reported (4, 5) that several mussel beds containing various species occurred in the Allegheny, Monongahela, and Ohio Rivers in 1805. However, such interesting tidbits of historical information are too scarce to provide a complete description of past conditions. A more broadly based historical characterization can be arrived at by considering the probable ecological impacts of channelization, the first major man-induced alteration of the river system. Prior to the construction of locks and dams, the "Three Rivers" consisted of alternating reaches of sluggish, deep pools and extremely shallow riffles (see Section 2.1.5.-Surface Hydrology). It can be hypothesized that the aquatic biota of that time was essentially composed of species typical of free-flowing, temperate zone rivers. Conversely, due to the present navigation system, the Ohio, Monongahela, and lower Allegheny Rivers ecologically behave much as a series of narrow connected impoundments. The navigable rivers are currently inhabited by lentic (lake-like) biota; moreover, they are essentially devoid of forms adapted exclusively to riffles. The following trends are at least partially due to the consequences of lock and dam construction, dredging, and snag-cleaning:

a.) Increased plankton biomass
b.) Increased zooplankton diversity
c.) Decreased aquatic macrophyte abundance
d.) Decreased benthos diversity
e.) Decreased fish diversity

Diversity decreased in benthos and fish are largely due to the fact that the aforementioned activities create rather uniform physical conditions throughout the rivers, thereby eliminating habitats such as riffles and shoals.

The many categories of water pollutants in the Pennsylvania ORBES region have further reduced the species diversity of aquatic organisms inhabiting the major rivers. Many pollution sensitive, lentic species which could conceivably exist with the constraints of the navigation system are nonetheless absent from the degraded reaches of the navigable rivers. Many free-flowing polluted tributary streams are likewise inhabited exclusively by pollution-tolerant organisms. The original aquatic biota of the basin were adapted to clear streams with gravel or sand substrates (1). However, in the late 1800's and early 1900's intensive lumbering resulted in dramatically increased erosion rates with an accompanying siltation of many streams (see Section 2.1.4.-Terrestrial Ecology). During the twentieth century acid mine drainage has been the big problem, rendering receiving waters acidic and blanketing their benthic communities with iron hydroxide precipitate (see Section 2.1.6.-Water Quality). Oxygen-demanding domestic wastewaters, toxic industrial wastewaters, and thermal effluents from power plants have also contributed to past impacts on the aquatic life of the Pennsylvania ORBES region.

Various miscellaneous factors have also altered the ecology of western Pennsylvania waterways. An often overlooked factor is the introduction of non-indigenous fish species. Thousands of hatchery reared rainbow trout (*Salmo gairdneri*) (a species native to the Pacific Coast), and brown trout (*Salmo trutta*) (a species native to Europe) are released in the Pennsylvania ORBES region every year. Competition and predation by such stocked trout doubtlessly alters the ecology of many small, cold water tributaries of the major rivers. Such streams are often stocked in numbers which are orders of magnitude beyond their natural carrying capacity. Moreover, preordained times and locations for trout stocking are published events in area newspapers, thereby producing a large crowd of fishermen which often cause additional adverse impacts (6). Carp (*Cyprinus carpio*), goldfish (*Carassius auratus*), eastern banded killifish (*Fundulus d. diaphanus*) and mummichog (*F. heteroclitus macrolepidotus*) were all introduced into the basin in the past. Carp are especially significant in that they are often the dominant fish species in polluted reaches of western Pennsylvania waterways, out-competing native benthophages.

C. Present Status

Biologists currently responsible for assessing the water quality of western Pennsylvania's rivers are acutely aware of the paucity of detailed information regarding the composition, diversity, and productivity of aquatic communities in the Upper Ohio River System. Furthermore, short-term studies which are undertaken often produce raw data that defies extensive interpretation due to the poor quality of the historical data base. Nonetheless, one trend seems obvious---the major rivers of the Pennsylvania ORBES region are currently undergoing a biotic recovery from the pollutional insults incurred during the past century. Only a few technical reports (7, 8, 9), mention or allude to this recovery. (More extensive documentation of this phenomenon can be witnessed in the bait shops and taverns of southwestern Pennsylvania, where the conversation often concerns catches of warm water game fishes from river reaches that were formerly devoid of fish or inhabited chiefly by pollution-tolerant rough species.) Indeed, as far as the general public is concerned, fish species composition and abundance are perhaps the most frequently used criteria for gauging the water quality of a river (10). The Youghiogheny, lower Allegheny, and upper Monongahela Rivers are good examples of recovery areas.

The reasons for the return of desirable aquatic life forms to the region are manifold. Past mine drainage abatement projects of the Pennsylvania Department of Environmental Resources have reclaimed a significant number of streams. The Federal Water Pollution Control Act Amendments (PL 92-500) have had profound ramifications in improving the quality of municipal and industrial effluents. Furthermore, several Corps of Engineers reservoirs are now operated with water quality considerations incorporated into their release schedules.

2.1.7.2. THE MONONGAHELA RIVER

A. Phytoplankton

Two water quality surveys of the Monongahela River were conducted by the U.S. Army Corps of Engineers (8) in the summer of 1975. The initial survey was performed in June during an intermediate flow regime (5,000-12,000 cfs*) at which time the phytoplankton concentrations of the various reaches were found to range between 64 and 1,439 cells/ml at a depth of one meter. The mean concentration at all of the sampling stations was calculated to be 515 cells/ml. A follow-up survey initiated in July during low flow conditions (650-1,800 cfs*) measured total phytoplankton concentrations ranging between 31 and 6,571 cells/ml along the length of the river with an average of 2,173 cells/ml for all stations (see Fig. 2.1.7.-1).

Microscopic examination of the samples collected during both 1975 water quality surveys disclosed the presence of 108 different phytoplankton taxa in the Monongahela River. This figure undoubtedly represents a somewhat conservative estimate of all Monongahela River algae species since several individuals were only keyed to the generic level and additional species probably went undetected because of their bionomy (e.g. deep water forms and species atypical of the summer community) or simply because of sampling error. The observed phytoplankton community was found to contain representative species from each of the five major taxonomic divisions; however, the euglenophytes and pyrrophytes were few in numbers of individuals and species. The green algae *Ankistrodesmus falcatus* and *Ankistrodesmus convolutus* and the blue-green alga *Schizothrix calcicola* were found to be numerically dominant in most reaches of the river. During the low flow survey diatom populations peaked at the headwaters and mouth of the Monongahela. The headwater peak was dominated by pennate forms such as *Synedra acus* and *Nitzschia acicularis*. The diatom peak observed at the river's mouth consisted largely of centric forms such as *Melosira granulata* and *Cyclotella menenghiniana*.

---

*extremes of mean daily flow along the entire length of the river.

Other numerically important phytoplankters of the Monongahela River are *Actinastrum hantzschii*, *Scenedesmus quadricauda*, and *Merismopedia glauca*. A list of phytoplankton genera recently identified from the "Three Rivers" is provided in Table 2.1.7.-3.

Algological analyses performed during the low flow survey are deemed to be especially valuable since the "biological zones" of the Monongahela River tend to manifest themselves during the critical water quality situation attendant to such flows. Williams (11) has noted that algological field studies performed during low flow are more meaningful, since phytoplankton populations can develop without the devastating influence of high velocity. During the 1975 Corps of Engineers (8) low flow survey abrupt decreases in total phytoplankton concentration were noted between river miles 35 and 24 (see Fig. 2.1.7.-1), a reach in which the Monongahela River water is used and warmed by the Mitchell and Elrama fossil fueled power plants.

The chemical analyses performed concurrently with the phytoplankton studies of the July low flow survey revealed the presence of acid mine drainage in the reach between river mile 90 and 60. The chemistry of this reach at low flow is governed largely by acid contributions from the Cheat River (see Section 2.1.6.-Water Quality). The reach was characterized by low total phytoplankton concentrations (see Fig. 2.1.7.-1) with a community dominated by *Ankistrodesmus* (see Fig. 2.1.7.-2). Populations of acid sensitive blue-green algae were noticeably small in this reach.

B. Periphyton

Attached growths were collected by the U.S. EPA from a station 0.8 miles upstream of the Monongahela's mouth in the spring of 1970 (12). This reach of the river receives substantial industrial wastewater discharges from the steel industry and such effluents influence the water quality of the reach (see Section 2.1.7.6-Water Quality). The periphyton of this reach was found to consist primarily of pollution tolerant species of blue-green algae. Relative to other concurrently sampled stations in the Upper Ohio River Basin, the periphyton of the lower Monongahela River station appeared to have an average cellular density, a low generic diversity and a low biomass (see Figs. 2.1.7.-3, 4, and 5).

C. Zooplankton

Limited zooplankton sampling was conducted by the Army Corps of Engineers (13) at three Monongahela River stations in April of 1975. Nine different zooplankton taxa were identified, five of these were rotifers (see Table 2.1.7.-4). These grab samples probably represent a conservative estimate of total zooplankton species since copepod nauplii and calanoid copepodites were not even keyed to the generic level. Moreover, the cool water temperatures and high turbidities typical of April undoubtedly serve to limit rotifer populations, which are generally the principal component of river zooplankton (14, 15).

D. Aquatic Macrophytes

Clarkson and Moore (16) identified twelve species of aquatic macrophytes in the Tygart Valley River, West Fork River, and West Virginia portion of the Monongahela River during the summers of 1965 and 1966. Their statistical correlations of physico-chemical and biological data demonstrated that the distribution of aquatic macrophytes within the upper basin was regulated by substrate type, phosphate content of the substrate, and the degree of water-level fluctuation. Moreover, the environmental perturbations caused by acid mine drainage did not exhibit any statistically significant effect on the distribution of these plants.

A superficial survey of aquatic macrophytes along the entire length of the Monongahela River was conducted by the Corps of Engineers in the summer of 1975 (8). Eleven of Clarkson and Moore's original twelve species were observed; furthermore, eight additional species were detected at this time (see Table 2.1.7.-5). Burweed (*Sparganium* sp.), arrowhead (*Sagittaria latifolia*), great bulrush (*Scirpus validus*), soft rush (*Juncus effusus*), and spikerushes (*Eleocharis* sp.) were the most commonly observed species. Emergent macrophyte communities were found to be abundant on the exposed mud flats of the L/D 3 and L/D 7 Pools. Both of these pools are impounded by fixed crest dams which permit fluctuation of the pool elevations. In pools behind gated dams the water levels are better controlled; consequently, submersed and floating leaved macrophytes are more common than emergent forms which under such conditions are essentially restricted to the mouths of tributary streams. The 1975 survey disclosed that submersed macrophytes were most common in the Maxwell Pool, a relatively transparent pool impounded by a gated dam.

E. Macrobenthos

Relative to the other benthic communities of the Upper Ohio River System, the macrobenthos of the lower Monongahela River may be characterized by a low species diversity (see Fig. 2.1.7.-6). Several field studies (12, 17, 18, 19) performed between 1960 and 1970 inclusive have noted this situation and have described a community that is generally dominated by pollution-tolerant midges such as *Cricotopus bicinctus* gr., *C. exilis* gr., *C. trifasciatus* gr., *C. junus*, *Polypedilum ophiodes* and *Chironomus riparius* have also been reported as typical benthos of lower Monongahela River. Benthological samples collected in 1975 at three stations along the entire length of the Monongahela River were likewise numerically dominated by pollution-tolerant oligochaetes and chironomids (13). The samples revealed a downstream trend of decreasing species diversity and organism density (see Table 2.1.7.-6).

The substrate of the lower Monongahela consists of soft mud and sand with certain areas downstream of McKeesport blanketed by oily sludges originating from steel mills. This situation is not deemed to be conducive to the development of a diverse benthic fauna.

F. Fish

The Monongahela River was originally inhabited by a diverse assemblage of freshwater fishes, including many pollution-sensitive species. Fish sampling performed in 1886 by Evermann and Bollman (20) near Pennsylvania-West Virginia border detected some forty different species. However, water pollution derived from intensive coal mining during the first half of the twentieth century contributed heavily to the ruination of this fishery (1). Moreover, industrial wastewater effluents in the lower Monongahela have further intensified the trend toward a decreased biotic diversity. Many reaches of the river, therefore, became either devoid of fish life or populated exclusively by pollution-tolerant species.

The fish populations of the upper Monongahela River are still subjected to environmental stress from acid mine drainage. Since 1967, the EPA and its predecessor agencies have conducted five fish population surveys at the Maxwell Locks and Dams (river mile 61.2), using rotenone in the lock chambers. Interpretation of this data is tenuous due to the few collections made and the questionable representativeness of the sampling technique. Nonetheless, the data do suggest a biotic recovery in this reach of the river. In 1967 no fish were captured and in 1968 only one small bluegill sunfish (*Lepomis macrochirus*) was taken. In 1969 and 1970 the standing crop increased slightly. However, pollution-tolerant species such as brown bullhead (*Ictalurus nebulosus*) and sunfishes (*Lepomis* sp.) were dominant. The sampling program at Maxwell Lock and Dam in 1973 produced results that Preston (7) believes are indicative of such biotic recovery. Total number of fishes, their standing crop, and species diversity were all found to have increased substantially. More importantly, many of the fishes captured at this time were pollution-sensitive species such as largemouth bass (*Micropterus salmoides*), channel catfish (*Ictalurus punctatus*), and emerald shiners (*Notropis atherinoides*). Table 2.1.7.-7 presents the changes in abundance and diversity detected during each of the five surveys. Table 2.1.7.-8 lists the various fish species captured.

The favorable results of the 1973 Maxwell fish sampling, in addition to existing physico-chemical water quality data, prompted the Pennsylvania Fish Commission to implement a warm water fish stocking program in the upper portion of the Monongahela River. At the present time, a respectable warm water fishery exists between the Pennsylvania-West Virginia border and the town of Monongahela in Washington County, Pennsylvania (21).

Pollutional loads added to the lower Monongahela River consist of industrial wastewaters, domestic wastewaters, and urban runoff. Acid mine drainage does enter the river in this reach, but not with the same severity as in the upper reaches. Fish surveys comparable to those conducted at Maxwell Lock and Dam were also performed at Lock No. 2 in the lower Monongahela River (river mile 11.2). The results of the surveys (1967-1973) at this station, although exhibiting an increase in standing crop, demonstrated very little improvement in the quality of the fishery (see Table 2.1.7.-7). Collections were dominated by pollution-tolerant species such as carp and brown bullhead (see Table 2.1.7.-8).

G. Ecologically Important Basin Streams

The Tenmile Creek Basin, Dunkard Creek Basin, and the lower Youghiogheny River support significant populations of warm water game and pan fishes (21). Smallmouth bass (Micropterus dolomieu) constitute the main warm water angling attraction in these streams. The most important cold water fisheries are located in the Youghiogheny River Basin in Fayette County, Somerset County, and a small corner of Westmoreland County. Big Sandy Creek, Little Sandy Creek, White's Creek, Laurel Hill Creek, Indian Creek, Dunbar Creek and the Upper Youghiogheny main stem are among the most significant cold water streams (22).

2.1.7.3. THE ALLEGHENY RIVER

A. Phytoplankton

Algological surveys were performed by the Corps of Engineers (23) in the navigable reach* of the Allegheny River during an intermediate flow regime in August 1976, an intermediate flow regime in June 1977, and a high flow regime in July 1977. The average total phytoplankton concentration for the entire navigable reach was determined to be in excess of 6,500 cells/ml.

The Allegheny River phytoplankton community is considerably more diverse than that of the Monongahela River. A total of 217 algal taxa were identified in the navigable reach of the Allegheny during 1976 and 1977. The greatest algal diversity (118 taxa) for any single navigation pool was detected at the L/D 9 Pool. Centric diatoms and chlorophytes were found to dominate the Allegheny River phytoplankton community. The most common genera were Cyclotella, Melosira, Asterionella, Scenedesmus, Dictyosphaerium, and a small unidentified coccoid chlorophyte resembling Palmella.

The significant biological zonation noted by the Corps of Engineers (8) in the Monongahela River was not observed in the Allegheny River (23). However, a trend toward decreased chlorophytes in relation to centric diatoms was observed near the middle of the navigable reach. Moreover, acid-sensitive, blue-green algae were observed to paradoxically increase in a reach polluted by acid mine drainage derived from the Kiskiminetas River; it was hypothesized that this phenomenon may be a response to increased nutrient levels.

B. Periphyton

Studies conducted between 1975 and 1977 revealed that the lower Allegheny River periphyton community at New Kensington, Clinton, and Kittanning is comprised almost entirely of diatoms; however, a few chlorophytes (Oedogonium, Scenedesmus, and Pediastrum) were also noted as occurring at these locales (24). In contrast, a study conducted by EPA (12) in 1970 near the mouth of the Allegheny described the periphyton community as consisting primarily of blue-green algae with several chlorophytes and very few diatoms (see Figs. 2.1.7.-3, 4, and 5).

---

*lower 72 miles

C. Zooplankton

Zooplankton collected in September of 1975 near New Kensington, Clinton, and Kittanning consisted of eight taxa of Cladocera, three taxa of copepods, twelve taxa of rotifers, and two taxa of protozoans (24). The total zooplankton concentrations at these three stations ranged between 409 and 1,190 individuals/M^3. The most common cladocerons were *Pleuroxus* sp. and *Bosmina longirostris*. Most of the copepods detected were in the larval stage of development (nauplii). *Kellicottia bostoniensis* and *Kellicottia* sp. accounted for a high numerical percentage of the rotifers.

D. Aquatic Macrophytes

In 1977 twelve taxa of vascular aquatic plants were identified in the L/D 3 and L/D 6 Pools of the Allegheny River (25) (see Table 2.1.7.-9). *Sagittaria-Eleocharis* communities were found to be common in backwater areas with silt and soft mud bottoms. An especially extensive *Sagittaria-Eleocharis* community was noted in the L/D 3 Pool near Tarentum. *Justicia* was cited as the most common aquatic vascular in the lower Allegheny; it was typically found growing on lightly silted, gravel shoals and around islands. *Justicia* was noted as being abundant in areas where the river channel was braided, especially in the L/D 6 Pool near Ford City. Koryak (25) notes that *Justicia* is absent from the Monongahela River; he speculates that this situation is due to the fact that the Monongahela, unlike the Allegheny, "has a generally undiversified ditch-like channel and no islands."

E. Macrobenthos

The Federal Water Pollution Control Administration sampled the Allegheny River for benthic macroinvertebrates in 1966 and 1967 (18, 26). Samples collected upstream of the confluence of the main stem with the Kiskiminetas River generally contained numerous benthic organisms from many invertebrate taxa, a situation indicative of a relatively unpolluted waterway. Hydropsychid caddisflies were numerically dominant in many of the samples. In contrast, samples collected downstream of the confluence with the acid mine drainage-degraded Kiskiminetas River (see Section 2.1.6.-Water Quality) contained few organisms and were dominated by pollution-tolerant chironomids and oligochaetes. Samples collected near Pittsburgh in the spring of 1970 (12) likewise revealed a sparse, undiversified benthic community (see Fig. 2.1.7.-6).

Recent studies conducted by the Corps of Engineers (24) in 1975 and 1977 between river miles 18 and 51 revealed that chironomids are the most prevalent group of Allegheny River macrobenthos, with *Procladius* sp. being the most abundant individual. However, tubificid worms generally constituted the majority of the biomass. The mayflies *Stenonema interpunctatum*, *S. nepotellum*, and *Hexagenia limbata* were also often detected, as were the caddisflies *Hydropsyche betteni*, *Neureclipsis* sp., and *Nyctiophylax* sp.

F. Fish

Fish sampling conducted from 1975 to 1977 at six stations between river miles eighteen and fifty-one revealed the presence of thirty-two species of fish in the Allegheny River (24). Various species of game fish including largemouth bass, smallmouth bass, walleye, northern pike, and channel catfish were captured during this survey (see Table 2.1.7.-10). Over the past several years there has been a surge of angling interest along this reach. The authors are aware of significant catches of walleye and smallmouth bass from "fishing holes" near Kittanning (r.m. 45.5), Acmetonia (r.m. 14.5), and even as far downstream as Sharpsburg (r.m. 6.6).

G. Ecologically Important Basin Streams

The majority of ecologically important Allegheny River tributaries drain the northern-most Pennsylvania ORBES counties. Tionesta, Sugar, and East Hickory Creeks in Forest County, Dennison Run in Venango County, Mill Creek, Schoolhouse Run, and the North Fork in Jefferson County are just a few of the streams supporting populations of native brook trout. In the southern portion of the basin (Westmoreland County) Powdermill Run and Loyalhanna Creek are cold water streams of special importance. The ecology of Powdermill Run has been extensively studied by the staff and associates of the Carnegie Museum of Natural History; consequently, this stream represents a "natural laboratory" for which there already exists a large data base. Loyalhanna Creek is of particular importance because, as noted in Section 2.1.4.-Terrestrial Ecology, it contains one of the few remaining hellbender populations in southwestern Pennsylvania.

Valuable warm water fisheries of the Allegheny River Basin occur in French Creek, Buffalo Creek, and the Allegheny main stem. French Creek is biologically unique in that it harbors the most diverse assemblage of freshwater mussels in the Pennsylvania ORBES region.

2.1.7.4 THE UPPER OHIO RIVER (PA)

Ecological conditions in the first forty miles of the Ohio River will be dealt with briefly herein, since the "ORBES Preliminary Technology Assessment Report" (27) includes a biological overview of the entire river.

A. Phytoplankton

Field studies of the Upper Ohio River (28, 29) have described a phytoplankton community dominated by *Melosira*, *Scenedesmus*, *Ankistrodesmus*, *Chlamydomonas*, *Cyclotella*, and *Dictyosphaerium*. Surveys conducted by the Corps of Engineers (29) in the summer and fall of 1974 indicate that during intermediate flow regimes the total phytoplankton concentration ranges between two and four thousand cells per milliliter. During high flows the community may be reduced and/or diluted to a few hundred cells per milliliter or less. The available data indicate that phytoplankton concentrations tend to be greatest in the lower sections of navigation pools where velocities are low.

B. Periphyton

Attached growths collected by the EPA in the spring of 1970 (12) were dominated by blue-green algae which comprised 50-86% of the cell count at all but one of the sampling stations (see Fig. 2.1.7.-3). Diatoms were also significant community members, comprising 8-32% of the cell count at, likewise, all but one station. The station deviating from the normal blue-green algae/diatom phycoperiphyton assemblage is located immediately downstream of the Allegheny County Sanitary Authority's (ALCOSAN's) wastewater effluent. At this station green algae comprised fifty percent of the cell count, a chlorophyte density greater than those observed at all other stations. More importantly, the conspicuous presence of protozoans* downstream of ALCOSAN (13% of the cell count) suggests that this waste source induces observable changes in the composition of the periphyton community. Increases in cellular density and chlorophyll content further downstream of ALCOSAN (see Figs. 2.1.7.-3 and 2.1.7.-5) were attributed to nutrient enrichment from this point source. Approximately fifteen miles downstream of the outfall these effects begin to reverse themselves. It should be noted however, that these observations are somewhat dated and that ALCOSAN's conversion to secondary treatment in 1974 may have eliminated or lessened spatial differences in the composition of attached communities.

C. Zooplankton

The Beaver Valley Power Station's pre-operational environmental impact studies characterized the zooplankton community of the Upper Ohio River (river miles 31-40) as being dominated by rotifers. Although cladocerans and copepods were frequently detected, rotifers always comprised at least 33% (by numbers) of the zooplankton and usually constituted over 50% (30). Aperiodic plankton analyses performed by the authors over the past nine years confirms this rotifer dominance for the entire Upper Ohio River in Pennsylvania. Common rotifers include species of Brachionus, Keratella, Polyarthra, and Synchaeta. Cladocerans consist mainly of Bosmina, Diaphanosoma, Ceriodaphnia, and Moina while copepods are represented by Cyclops, Tropocyclops, Mesocyclops, and Diaptomus.

D. Aquatic Macrophytes

Heavy industrialization along the banks of the Upper Ohio River has greatly reduced the availability of sites for the growth of aquatic vasculars. Consequently, emergent macrophytes are relatively scarce. A survey conducted by the Corps of Engineers in 1975 identified only ten narrow bands of significant growth on the reach within the Pittsburgh Corps' District (31). These bands were generally located at sites on the back channel sides of islands. Sagittaria and Eleocharis were identified as the most common genera although Sparganium was frequently detected in deeper water.

E. Macrobenthos

The most recent studies (12, 30) indicate that the benthic fauna of the Upper Ohio River is composed primarily of oligochaetes with lesser numbers of the midges Psectrocladius sp., Cricotopus gr. bicinctus, and C. trifasciatus. Minor components include the amphipod Crangonyx sp., the crayfish Orconectes sanborni, the damselfly Enallagma exulans, and several other miscellaneous invertebrates. The EPA field study of 1970 (12) noted that oligochaetes were most abundant at three stations (see Fig. 2.1.7.-6) immediately downstream of significant sources of iron-bearing wastewater; it was hypothesized that iron precipitates and filamentous iron-bacteria provide a more suitable substrate for these burrowing organisms than bare rocks.

---

*Protozoans thrive on bacteria and minute sewage particles.

F. Fish

Lock chamber studies conducted annually 1968-1970 and 1975-1976 at Dashields Lock and Dam (river mile 13.3) have disclosed the presence of thirty-four species of fish (see Table 2.1.7.-8) for the entire period of examination; however, only sixteen to nineteen species have been captured in any given year. Data from each survey year reveals that the Dashields sampling station typically exhibits a lower fish species diversity than downstream stations. Along the entire length of the Ohio River, eighty-two species of fish have been captured during the history of these surveys. Several individual downstream stations have yielded more than forty species for the period of examination and in excess of thirty species for individual years (32). Moreover, fish biomass estimates for the period of record at Dashields shows that 76% of the biomass is composed of rough species, whereas at most downstream stations these pollution-tolerant species constituted less than 50% of the biomass.

G. Ecologically Important Sub-basin Streams

Most streams in the Upper Ohio River Basin would be incapable of supporting a naturally reproducing cold water fishery and much of its associated biota even if all pollutional insults were removed tomorrow (33). This seeming pecularity is due to the hydrologic, topographic, and geologic characteristics of the land area which favor low gradient, warm water streams. The notable exception to this generalization is the portion of Slippery Rock Creek and its tributaries located in McConnells Mill State Park (Lawrence County). Several warm water streams are, however, significant in that they support natural populations of smallmouth bass and stocked populations of walleye and tiger muskellunge. Areas of particular importance are:

a). Connoquenessing Creek in Butler, Lawrence, and Beaver Counties
b). The lower reaches of Slippery Rock Creek in Lawrence County
c). The Wheeling and Buffalo Creek Watersheds in Greene and Washington Counties
d). Portions of the Shenango River in Mercer and Lawrence Counties

2.1.7.5 EXECUTIVE SUMMARY

The "mishmash" of taxonomic names so typical of environmental impact statements, ecological baseline documents, and natural resource inventories provides lengthy lists of species, which generally defy analysis and therefore prove to be nonutilitarian. Conversely, detailed statistical analysis of aquatic ecological data for the entire Pennsylvania ORBES region is not only impractical, but dangerous, since field studies are aperiodic and often cursory. Perhaps the most logical method of simplifying this portion of the baseline document is to rank areas as to their relative diversity of aquatic life. For example, most western Pennsylvania fishermen are aware of the following trend:

QUALITY OF SPORT FISHERY

Upper Allegheny River > Lower Allegheny River > Upper Monongahela River > Ohio River in Pa. > Lower Monongahela River

Relative rankings become more difficult to assign as one considers other forms of aquatic biota and tributary streams. Nonetheless, in Figure 2.1.7.-7 we attempt to make some generalizations for entire counties based upon the diversity of fish, other fully aquatic vertebrates, freshwater mollusks, and aquatic insects in the flowing waters of western Pennsylvania. These relative rankings are based upon our field collections, and the field experience of friends and colleagues in the region, as well as species information provided in recent reports of state and federal environmental agencies.

As can be seen in Figure 2.1.7.-7, the most diverse aquatic communities are located in sparsely populated areas to the north and east of Pittsburgh.

TABLE 2.1.7.-1

IMPACTED* FISH SPECIES OF THE UPPER OHIO RIVER BASIN

paddlefish (*Polyodon spathula*)
lake sturgeon (*Acipenser fulvescens*)
shovelnose sturgeon (*Scaphirhynchus platorhynchus*)
shortnose gar (*Lepisosteus platostomus*)
highfin sucker (*Carpiodes velifer*)
river carpsucker (*Carpiodes carpio*)
Blue sucker (*Cycleptus elongatus*)
sturgeon sucker (*Catostomus catostomus*)
sauger (*Stizostedion canadense*)
bowfin (*Amia calva*)
goldeye (*Hiodon alosoides*)
smallmouth buffalo (*Ictiobus bubalus*)
river shiner (*Notropis blennius*)
silvery minnow (*Hybognathus nuchalis*)
blue catfish (*Ictalurus furcatus*)
American eel (*Anguilla rostrata*)
freshwater drum (*Aplodinotus grunniens*)

*Hostorical evidence suggests that these species have undergone population reductions or extirpations since colonial times.

SOURCE: Adapted from Lachner (1).

TABLE 2.1.7.-2

PENNSYLVANIA FISH COMMISSION
LIST OF ENDANGERED (1), THREATENED (2), OR STATUS INDETERMINATE (3) FISHES

Common Name	Scientific Name	Status
*Shortnose sturgeon	Acipenser brevirostrum	1
Lake sturgeon	Acipenser fulvescens	1
Threespine stickleback	Gasterosteus aculeatus	1
*Blue pike	Stizostedion vitreum glaucum	1
Eastern sand darter	Ammocrypta pellucida	2
Northern brook lamprey	Ichthyomyzon fosser	3
Silver lamprey	Ichthyomyzon unicuspis	3
Sea lamprey	Petromyzon marinus	3
Atlantic sturgeon	Acipenser oxyrhynchus	3
Spotted gar	Lepisosteus oculatus	3
Cisco	Coregonus artedii	3
Lake whitefish	Coregonus clupeaformis	3
Southern redbelly dace	Phoxinus erythrogaster	3
Gravel chub	Hybopsis x-punctata	3
Hornyhead chub	Nocomis biguttatus	3
Silver chub	Hybopsis storeriana	3
River shiner	Notropis blennius	3
Blackchin shiner	Notropis heterodon	3
Blacknose shiner	Notropis heterolepis	3
Redfin shiner	Notropis umbratilis	3
Spotted sucker	Minytrema melanops	3
Black bullhead	Ictalurus melas	3
Mountain madtom	Noturus eleutherus	3
Tadpole madtom	Noturus gyrinus	3
Brindled madtom	Noturus miurus	3
Northern madtom	Noturus stigmosus	3
Burbot	Lota lota	3
Warmouth	Lepomis gulosus	3
Orangespotted sunfish	Lepomis humilis	3
Longear sunfish	Lepomis megalotis	3
Spotted bass	Micropterus punctulatus	3
Bluebreast darter	Etheostoma camurum	3
Spotted darter	Etheostoma maculatum	3
Tippecanoe darter	Etheostoma tippecanoe	3
Channel darter	Percina copelandi	3
Longhead darter	Percina macrocephala	3
Sauger	Stizostedion canadense	3

Status categories are defined as follows:

1. Endangered: Actively threatened with extinction in the state. Continued survival unlikely without special protective measures.
2. Threatened: Not under immediate threat of extinction in the state, but occurring in such small numbers and/or in such restricted habitat that it could quickly cease to be a part of the state fauna.
3. Indeterminate: Apparently threatened or uncommon to rare, but insufficient data currently available on which to base a reliable assessment of status.

*Also classified as U.S. endangered.

SOURCE: Adapted from Pa. Fish Commission (2), U.S. Fish and Wildlife Service (3).

TABLE 2.1.7.-3

MAJOR PHYTOPLANKTON GENERA OF THE MONONGAHELA, LOWER* ALLEGHENY AND UPPER** OHIO RIVERS

I. CYANOPHYTA (Blue-Green Algae)

Anabaena
Anacystis
Aphanizomenon
Aphanocapsa
Chroococcus
Coelosphaerium
Gomphosphaeria
Lyngbya
Merismopedia
+Microcystis
+Oscillatoria
+Schizothrix
Cyanophyta g. sp.

II. CHLOROPHYTA

+Actinastrum
+Ankistrodesmus
Carteria
Characiopsis
+Chlamydomonas
Closterium
Closteriopsis
Coelastrum
Cosmarium
Crucigenia
+Dictyosphaerium
Echinosphaerella
Elakatothrix
Eremosphaera
Franceia
Golenkinia
Gonium
Haematococcus
Kirchneriella
Lagerheimia
Micractinium
Mougeotia
Oocystis
Pandorina
Pediastrum
Phacotus
Planktosphaeria
Quadrigula
+Scenedesmus
Schroederia
Selenastrum
Sphaerocystis
Staurastrum
Tetraedron
Treubaria
+Chlorophyta g. sp.

III. CHRYSOPHYTA

Achnanthes
Amphiprora
+Asterionella
Cocconeis
Coscinodiscus
+Cyclotella
Cymatopleura
Cymbella
Diatoma
Dinobryon
Diploneis
Epithemia
Eunotia
+Fragilaria
Frustulia
Gomphonema
Gyrosigma
Hantzschia
Mallomonas
Mastogloia
+Melosira
Meridion
Navicula
+Nitzschia
Pinnularia
Pleurosigma
Rhoicosphenia
Stauroneis
+Stephanodiscus
Surirella
Synedra
Tabellaria
Chrysophyta g. sp.

IV. PYRROPHYTA

Ceratium
Glenodinium
Peridinium

V. EUGLENOPHYTA

Chroomonas
+Cryptomonas
Euglena
Lepocinclis
Phacus
Rhodomonas
Trachelomonas

*Navigable Reach
**Within the State of Pennsylvania

+Indicates that species of this genera are often numerically dominant

TABLE 2.1.7 - 4

ZOOPLANKTON TAXA OF THE MONONGAHELA RIVER
APRIL 1975

Name of Organism	River Mileage of Sampling Stations		
	7.0	63.0	89.0
Rotifera			
Brachionus sp.	X	X	X
Euchlanis sp.		X	
Filinia longiseta	X		
Keratella cochlearis	X	X	X
Rotaria sp.			X
Cladocera			
Bosmina sp.		X	
Chydorus sp.	X	X	
Copepoda			
Nauplius	X	X	X
Calanoid copepodite	X		

SOURCE: U.S. Army Corps of Engineers (13).

TABLE 2.1.7. - 5

AQUATIC MACROPHYTES OF THE MONONGAHELA RIVER
SUMMER 1975

Scientific Name	Common Name
Equisetum fluviatile L.	Water Horsetail
Typha latifolia L.*	Common Cattail
Sparganium sp.*	Bur Weed
Potamogeton pusillus L.	Slender pondweed
Potamogeton ephydrus Raf.*	Floating pondweed
Potamogeton nodosus Poir.*	Longleaf pondweed
Alisma subcordatum Raf.	Broadleaf water plantain
Sagittaria graminea Michx.*	Slender arrowhead
Sagittaria latifolia Willd.*	Broadleaf arrowhead
Elodea canadensis Michx.	Waterweed
Cyperus ferruginescens Boeckl.	An umbrella sedge
Eleocharis acicularis L. R+S*	Slender spikerush
Eleocharis obtusa (Willd.) Schuttes	Blunt spikerush
Scirpus validus Vahl.*	Great bulrush
Juncus effusus L.*	Soft rush
Iris pseudacorus L.	Yellow iris
Polygonum lapathifolium L.	Nodding smartweed
Callitriche palustris L.	Water starwort
Ludwegia palustris (L.) Ell.*	Water purslane
Myriophyllum heterophyllum Michx.*	Variable watermilfoil

* Also collected by Clarkson and Moore (16) on the upper Monongahela, West Fork, and Tygart Valley Rivers. Additionally, they collected Potamogeton diversifolius, not listed above

SOURCE: U.S. Army Corps of Engineers (8).

TABLE 2.1.7 - 6

DENSITY OF BENTHIC MACROINVERTEBRATES COLLECTED AT MONONGAHELA RIVER STATIONS DURING APRIL, 1975

Organisms	River Mileage 7.0	63.0	89.0
	Density (no./m^2)		
Oligochaeta			
Tubificidae			
Limnodrilus claparedeanus			19.0
Limnodrilus hoffmeisteri			76.2
Limnodrilus (immature)	28.6	57.1	142.9
Diptera			
Chironomidae			
Cricotopus sp. (unidentified)			9.5
Chaetocladius sp.			19.0
Endochironomus dimorphus			409.5
Polypedilum sp.			47.6
Procladius (*Procladius*) sp.			152.4
Procladius (*Psilotanypus*) *adumbratus*		19.0	38.1
Tipulidae			
Tipula sp.			9.5
Collembola			
Isotomurus palustris	19.0		
Pelecypoda			
Sphaeriidae			
Pisidium (*Cyclocalyx*) *adamsi*		9.5	
Total Density	47.6	95.1	923.8

SOURCE: U.S. Army Corps of Engineers (13).

TABLE 2.1.7.-7

SUMMARY OF FISH SAMPLING DATA FROM THE MONONGAHELA RIVER 1967-1973

		1967	1968	1969	1970	1973
MAXWELL LOCK (1.4 surface acres)	Total number fish	0	1	204	54	8,071
	Total weight fish (lbs.)	0	0.04	6.43	6.76	91.50
	Standing crop (lbs./acre)	0	0.03	4.59	4.83	65.36
	Number of species	0	1	8	6	16
	Percentage sensitive species (by total weight)	-	-	18	23	65
LOCK NO. 2 (0.5 surface acres)	Total number fish	20	207	1,626	261	869
	Total weight fish (lbs.)	2.58	27.33	58.33	45.70	74.48
	Standing crop (lbs./acre)	5.16	54.66	116.66	91.40	148.96
	Number of species	4	8	12	12	16
	Percentage sensitive species (by total weight)	26	9	6	12	31

SOURCE: Adapted from Preston (7).

TABLE 2.1.7.-8

FISHERY SURVEY RESULTS FOR REACHES
OF THE MONONGAHELA AND OHIO RIVERS IN PENNSYLVANIA

		Upper Ohio River (Pa.)		Monongahela River (Pa.)	
Family Species	Common Name	Dashields Lock[a]	Montgomery Lock[b]	Maxwell Lock[c]	Lock No. 2[c]
Clupeidae					
Dorosoma cepedianum	Gizzard shad	X	X	X	X
Cyprinidae					
Carassius auratus	Goldfish	X		X	X
Cyprinus carpio	Carp	X	X	X	X
Notemigonus crysoleucas	Golden shiner				X
Notropis atherinoides	Emerald shiner	X	X	X	X
Notropis spilopterus	Spotfin shiner	X	X		X
Notropis stramineus	Sand shiner	X	X	X	X
Notropis volucellus	Mimic shiner	X	X		X
Notropis boops	Bigeye shiner	X			
Notropis blennius	River shiner	X			
Pimephales notatus	Bluntnose minnow	X	X		X
Pimephales promelas	Fathead minnow				X
Catostomidae					
Catostomus commersoni	White sucker	X			X
Moxostoma erythrurum	Golden redhorse			X	
Moxostoma duquesnei	Black redhorse	X			
Ictaluridae					
Ictalurus catus	White catfish	X	X	X	
Ictalurus natalis	Yellow bullhead	X	X		X
Ictalusus nebulosus	Brown bullhead	X	X	X	X
Ictalurus melas	Black bullhead		X		
Ictalurus punctatus	Channel catfish	X	X	X	X
Pylodictus divarius	Flathead catfish	X			
Cyprinodontidae					
Fundulus diaphanus	Banded killifish	X	X		X
Percichthyidae					
Morone chrysops	White bass	X			

Family Species	Common Name	Upper Ohio River (Pa.)		Monongahela River (Pa.)	
		Dashields Lock[a]	Montgomery Lock[b]	Maxwell Lock[c]	Lock No. 2[c]
Centrarchidae					
Ambloplites rupestris	Rock bass	X	X	X	X
Lepomis cyanellus	Green sunfish		X	X	X
Lepomis gibbosus	Pumpkinseed	X	X	X	X
Lepomis humilis	Orangespotted sunfish			X	
Lepomis macrochirus	Bluegill	X	X	X	X
Lepomis microlophus	Redear sunfish	X			
Micropterus dolomieu	Smallmouth bass			X	
Micropterus salmoides	Largemouth bass	X	X	X	X
Micropterus punctulatus	Spotted bass	X			
Pomoxis annularis	White crappie	X			
Pomoxis nigromaculatus	Black crappie	X	X	X	
Percidae					
Percina caprodes	Logperch	X			
Perca flavescens	Yellow perch	X			
Stizostedion vitreum	Walleye	X	X		
Stizostedion canadense	Sauger	X			
Anguillidae					
Anguilla rostrata	American eel	X			
Sciaenidae					
Aplodinotus grunniens	Freshwater drum	X			
Esocidae					
Esox masquinongy	Muskellunge	X			

a. Lock chamber sampling conducted in 1968-1970; 1975-1976
b. Lock chamber sampling conducted in 1968-1970
c. Lock chamber sampling conducted in 1967-1973

Adapted from Preston (7) and Preston and White (32).

TABLE 2.1.7.-9

AQUATIC MACROPHYTES OF THE ALLEGHENY RIVER
1977

Scientific Name	Common Name
Sparganium americanum Nutt.	Burr Weed
Potamogeton crispus L.	Curly pondweed
Potamogeton nodosus Poir.	Longleaf pondweed
Potamogeton sp.	Pondweed
Sagittaria latifolia Willd.	Broadleaf - arrowhead
Sagittaria graminea Michx.	Slender arrowhead
Eleocharis acicularis (L.) R + S	Slender Spikerush
Scirpus validus Vahl	Great bulrush
Scirpus americanus Pers.	Three-square rush
Polygonium coccineum Muhl.	Smartweed
Myriophyllum sp.	Watermilfoil
Justicia americana (L.) Vahl	Water willow

SOURCE: Koryak (25).

TABLE 2.1.7.-10

SPECIES OF FISH COLLECTED*
FROM POOLS 3, 5, and 7 OF THE ALLEGHENY RIVER
1975 - 1977

Family Cyprinidae

Carp (3, 5, 7)
Goldfish (3, 7)
Streamline Chub (7)
Creek Chub (3, 7)
Golden Shiner (5, 7)
Stoneroller (5)
Emerald Shiner (3, 5, 7)
Spotfin Shiner (3, 5, 7)
Mimic Shiner (3, 5, 7)
Rosyface Shiner (3, 5, 7)
Sand Shiner (3)
River Shiner (3, 5, 7)
Common Shiner (7)
Silver Shiner (7)
Striped Shiner (7)
Bluntnose Minnow (3, 5, 7)

Family Catostomidae

Northern Hogsucker (3, 5, 7)
White Sucker (3, 7)
Smallmouth Buffalo (3)
Quillback (3, 7)
Golden Redhorse (3, 5, 7)
Silver Redhorse (3, 7)
Black Redhorse (3, 7)
Shorthead Redhorse (3, 5, 7)
River Redhorse (5)

Family Centrarchidae

Rock Bass (3, 5, 7)
Bluegill (5, 7)
Pumpkinseed (3, 7)
Largemouth Bass (3, 7)
Smallmouth Bass (3, 5, 7)
White Crappie (5, 7)

Family Percidae

Logperch (3, 5, 7)
Yellow Perch (3, 5, 7)
Walleye (3, 5, 7)
Fantail Darter (7)
Banded Darter (3, 5)
Johnny Darter (3, 5, 7)

Family Percopsidae

Trout - Perch (3, 5, 7)

Family Cyprinodontidae

Banded Killifish (5)

Family Ictaluridae

Channel Catfish (3, 5, 7)
Flathead Catfish (3, 7)
Brown Bullhead (3, 5)

Family Esocidae

Northern Pike (3, 7)

Family Clupeidae

Gizzard Shad (3, 5)

Family Cottidae

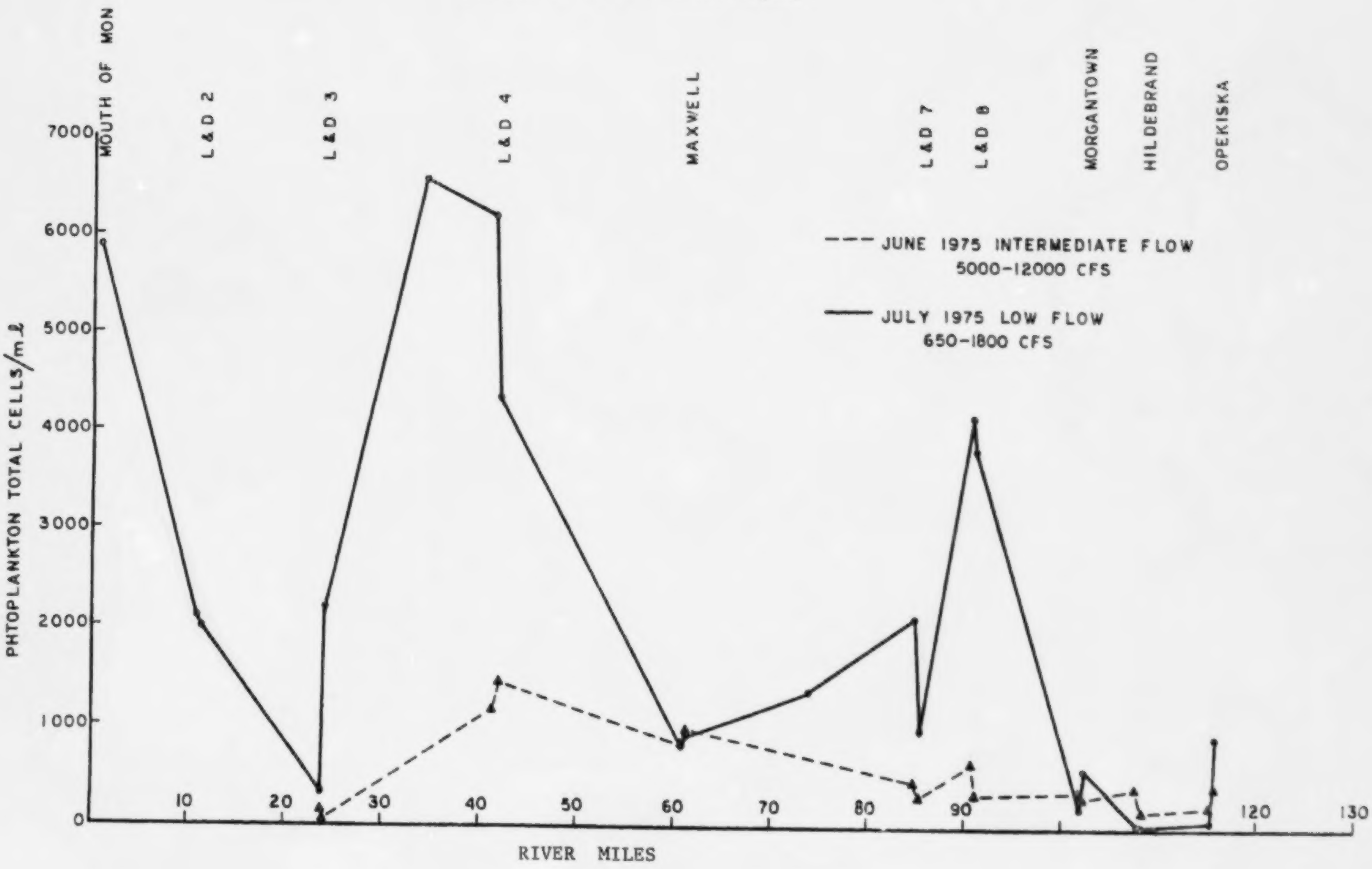
Mottled Sculpin (7)

*Collections made by electrofishing, experimental gill netting, bag seining, and towing half-meter larval fish nets. Numbers in parentheses indicate Navigation Pools where that particular species was detected.

SOURCE: Adapted from U.S. Army Corps of Engineers (24).

FIGURE 2.1.7 - 1

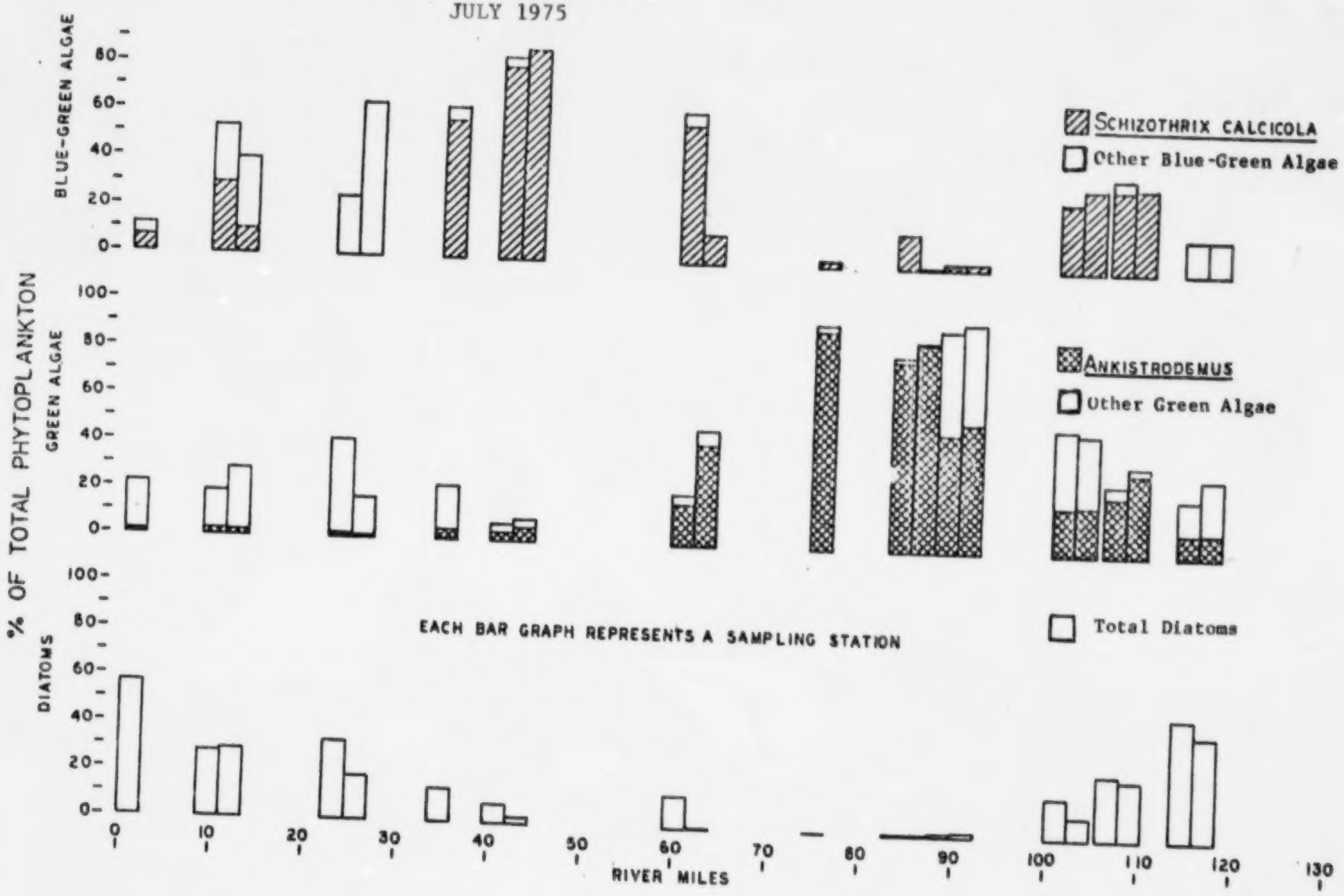
MONONGAHELA RIVER TOTAL PHYTOPLANKTON
(midstream at one meter depth)



SOURCE: U.S. Army Corps of Engineers (8)

FIGURE 2.1.7 - 2

COMPOSITION OF MONONGAHELA RIVER
PHYTOPLANKTON COMMUNITY
JULY 1975

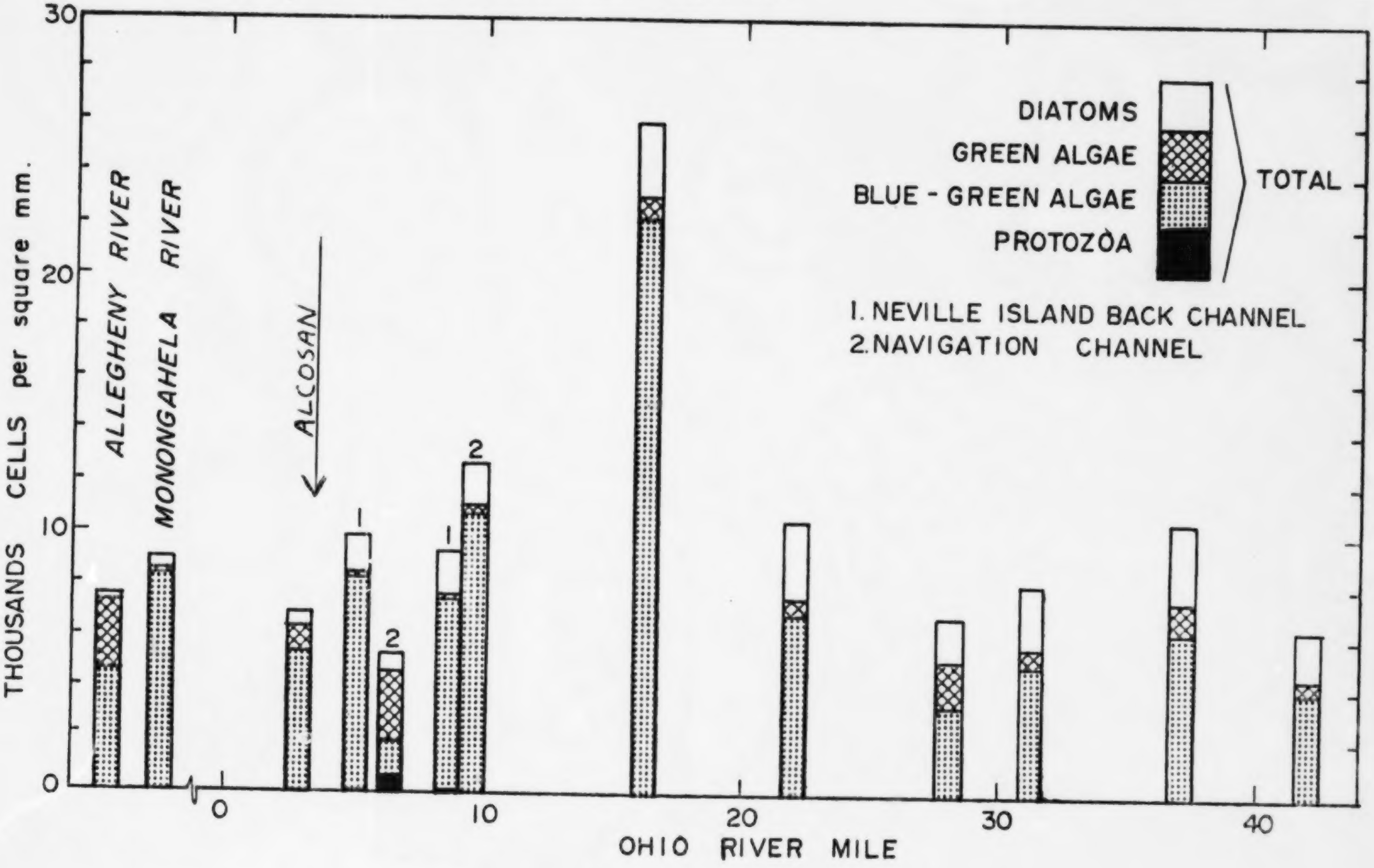


SOURCE: U.S. Army Corps of Engineers (8)

FIGURE 2.1.7 - 3

NUMBERS AND COMPOSITION OF ATTACHED GROWTHS

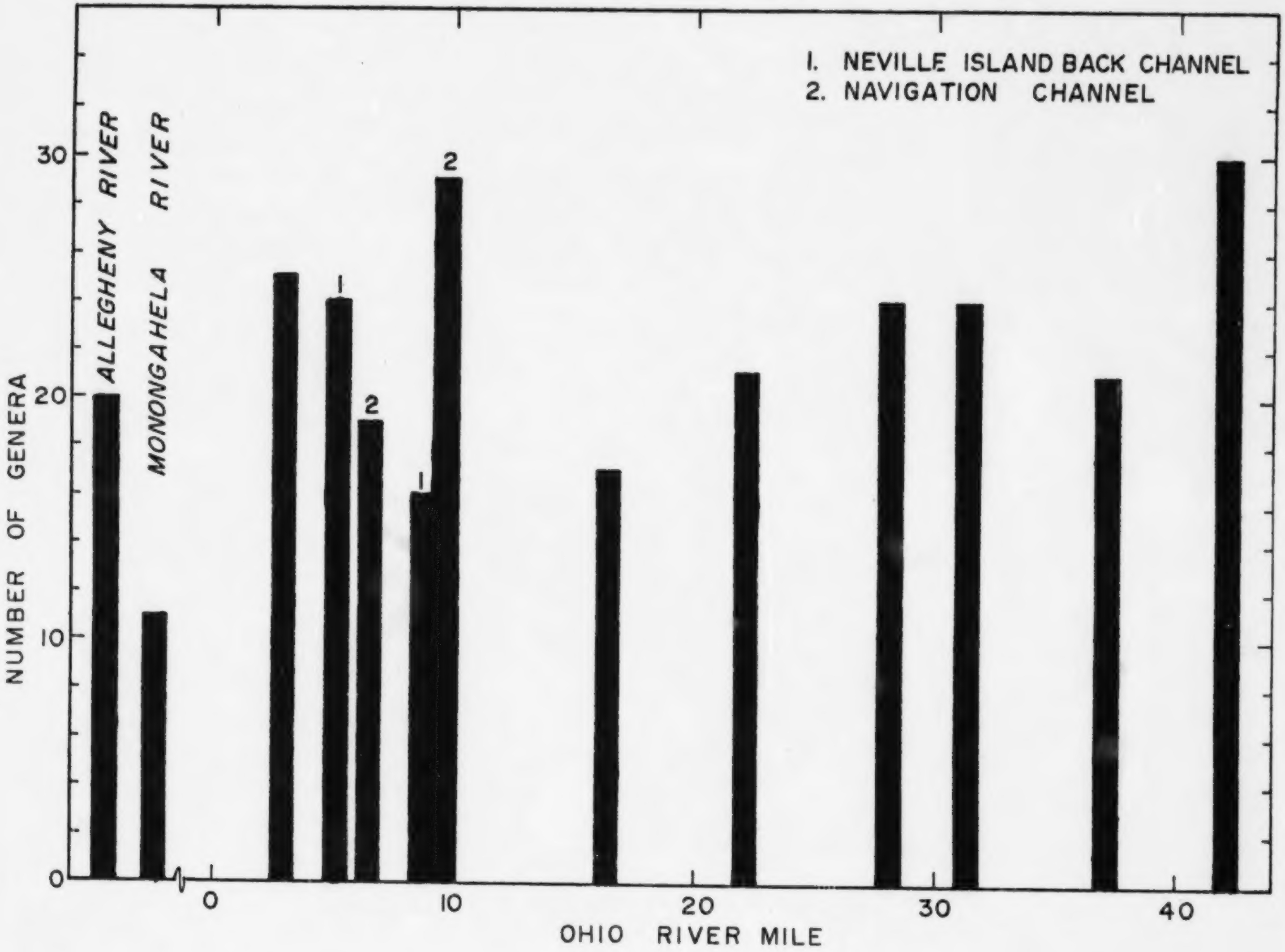
UPPER OHIO RIVER SYSTEM, MAY - JUNE 1970



SOURCE: U.S. EPA (12).

FIGURE 2.1.7 - 4

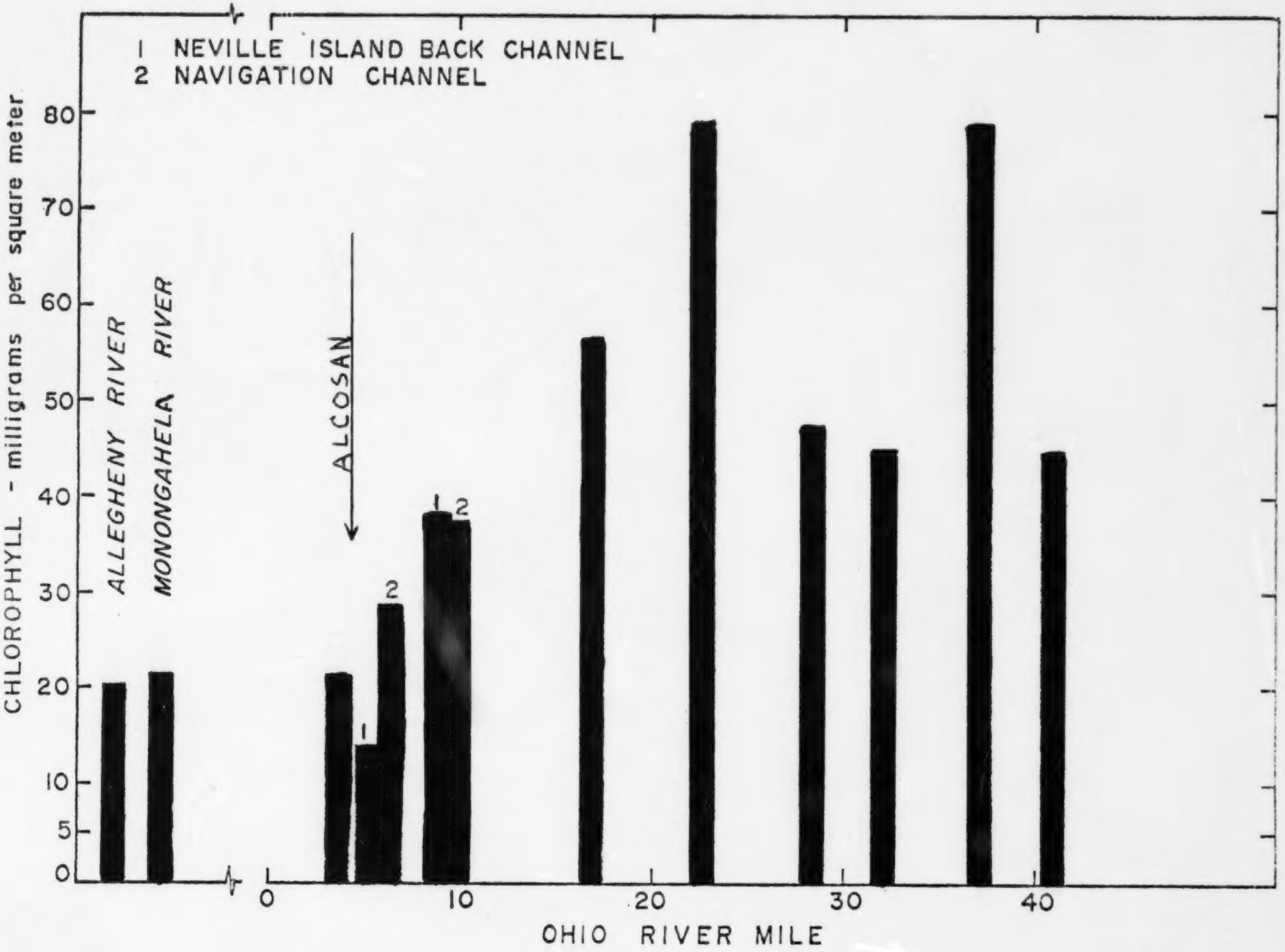
NUMBER OF PERIPHYTON GENERA IN THE ATTACHED GROWTH COMMUNITIES
IN THE UPPER OHIO RIVER SYSTEM, MAY - JUNE 1970.



SOURCE: U.S. EPA (12).

FIGURE 2.1.7 - 5

QUANTITY OF CHLOROPHYLL IN THE ATTACHED GROWTH COMMUNITIES OF THE UPPER OHIO RIVER SYSTEM, MAY - JUNE 1970



SOURCE: U.S. EPA (12).

FIGURE 2.1.7 - 6

BENTHIC FAUNA COLLECTED IN ROCK BASKET SAMPLERS, UPPER OHIO RIVER BASIN

MAY - JUNE 1970

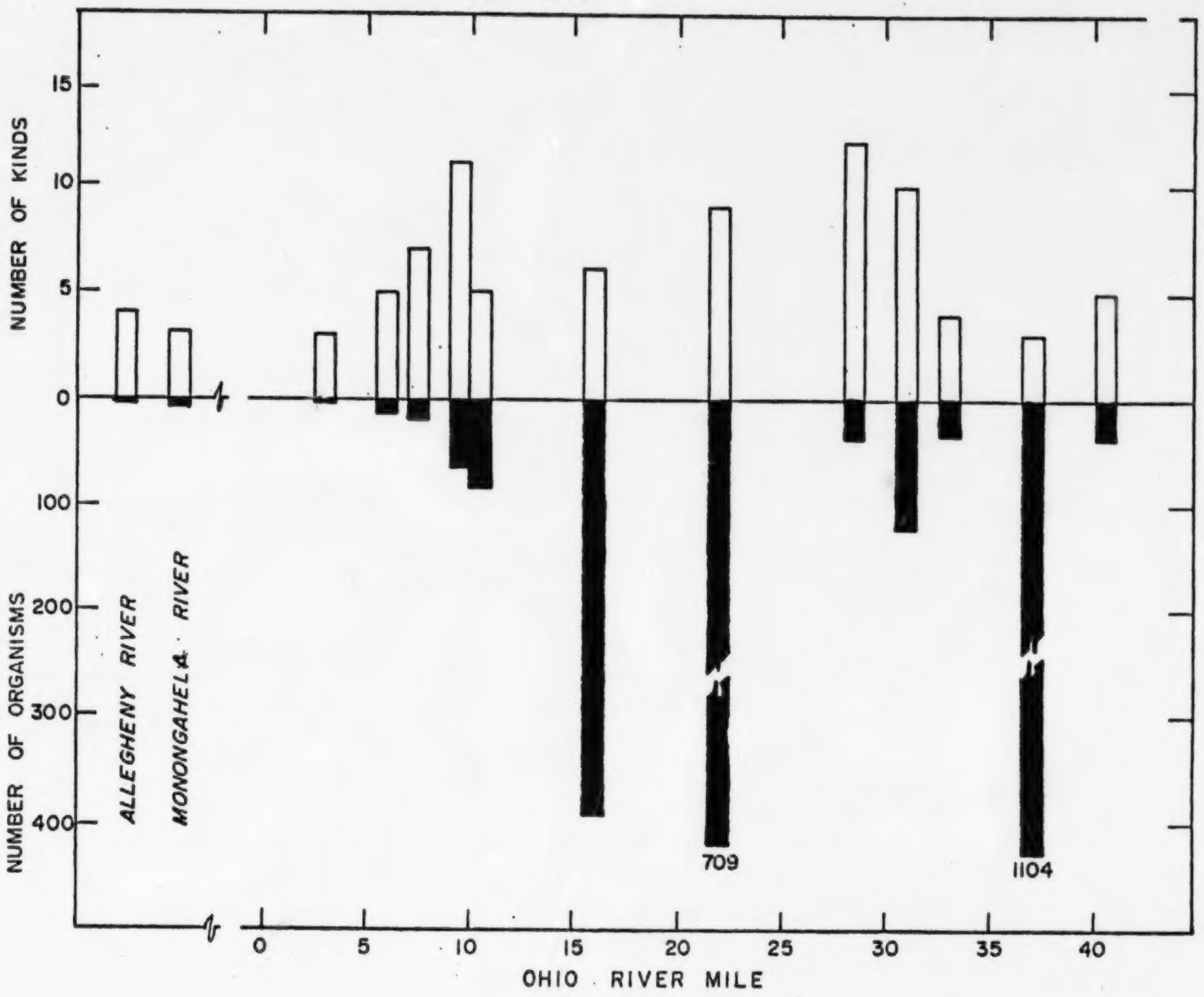
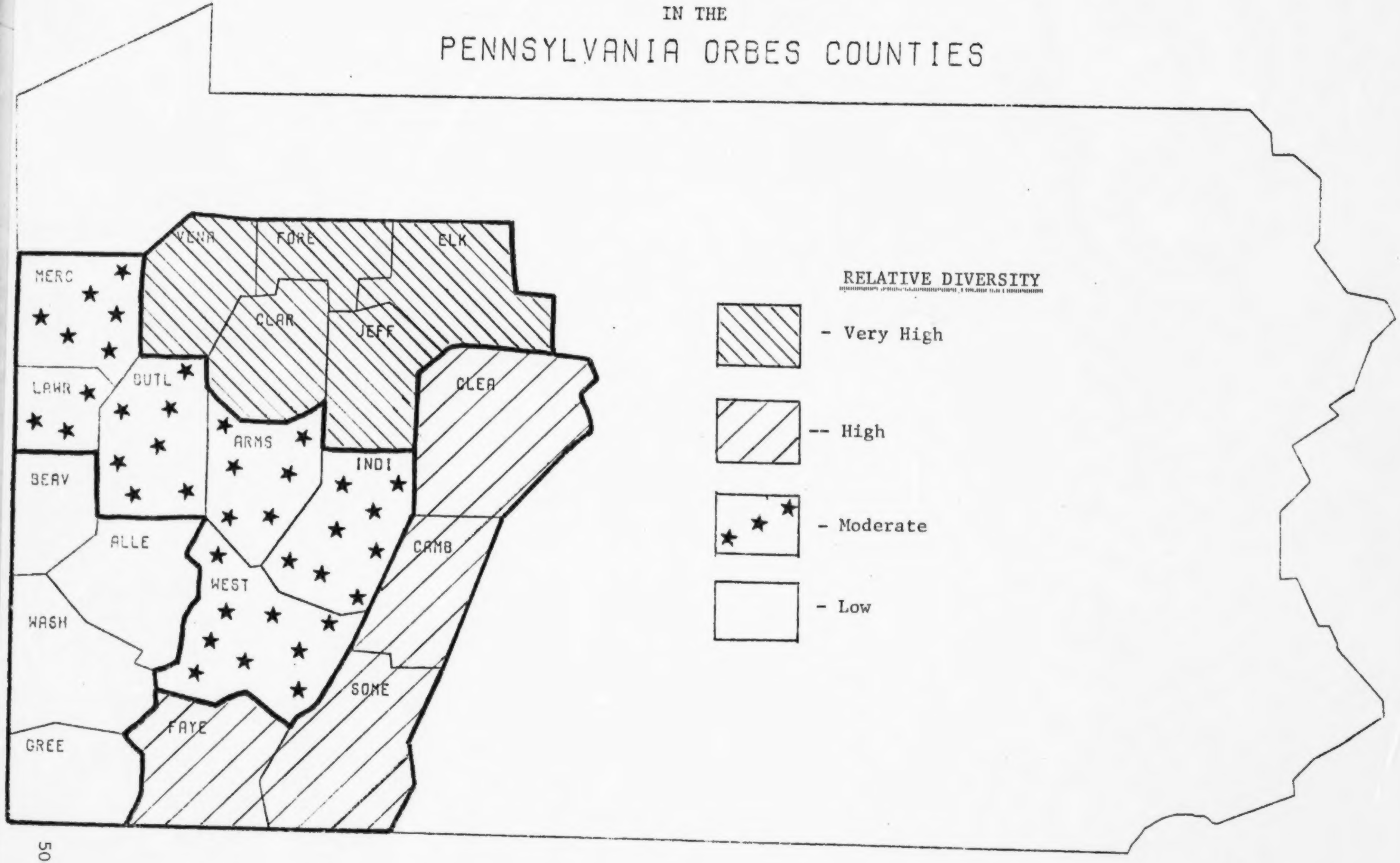


FIGURE 2.1.7.-7

RELATIVE DIVERSITY OF AQUATIC FAUNA

IN THE

PENNSYLVANIA ORBES COUNTIES



MERC
VENA
FORE
ELK
CLAR
JEFF
CLEA
LAWR
BUTL
ARMS
INDI
BEAV
ALLE
CAMB
WEST
WASH
SOME
FAYE
GREE
RELATIVE DIVERSITY
- Very High
-- High
- Moderate
- Low

REFERENCES

1. E.A. Lachner. "The Changing Fish Fauna of the Upper Ohio Basin". In: Man and the Waters of the Upper Ohio Basin. C.A. Tryon, and M.A. Shapiro (eds). Spec. Publ. No. 1, Pymatuning Laboratory of Field Biology, University of Pittsburgh, Linesville, Pa., 1956.

2. Pennsylvania Fish Commission. "A New List of Endangered Threatened or Status Indeterminate Fishes, Amphibians and Reptiles." Bellefonte, Pa., 1977.

3. U.S. Fish and Wildlife Service. "A Checklist of the Fishes of Pennsylvania." State College, Pa., 1977.

4. F.A. Michaux. "Travels to the West of the Allegheny Mountains." In: Early Western Travels 1748-1846, Vol. 3, R.G. Thwaites (ed.) A.H. Clar Publishing Co., 1805.

5. Ohio River Sanitation Commission. "Aquatic-life Resources of the Ohio River". Cincinnati, Ohio 1962.

6. Pennsylvania Game Commission and the National Audubon Society. "Proceedings of the Symposium on Nongame Species, October 1, 1977." T. Williams (ed.), Harrisburg, Pa. 1978.

7. H.R. Preston. "Monongahela River Basin Aquatic Biology - Part I Fish Populations." U.S. EPA Region III, Wheeling, West Virginia, 1974.

8. U.S. Army Corps of Engineers, Pittsburgh District. "Monongahela River Navigation Projects Annual Water Quality Report 1976". Pittsburgh, 1976.

9. Pennsylvania Department of Environmental Resources, Bureau of Water Quality Management. "Pennsylvania 1976 Water Quality Inventory". Publ. No. 42, Harrisburg, Pa., 1976.

10. U.S. Environmental Protection Agency, Office of Research and Development. "Biological Field and Laboratory Methods for Measuring the Quality of Surface Waters and Effluents". C.I. Weber (ed.) EPA 670/4-73-001, Cincinnati, Ohio 1973.

11. L.G. Williams, "Possible relationships between plankton-diatom species numbers and water quality estimates". Ecology 45:809-823 1964.

12. U.S. Environmental Protection Agency Region III. "A Report on Pollution of the Ohio River and its Tributaries in the Pittsburgh Pennsylvania Area." Philadelphia, P , 1971.

13. U.S. Army Corps of Engineers, Pittsburgh District. Monongahela River - Draft Environmental Statement on the Operation and Maintenance of the Navigation System." Pittsburgh, PA,1975.

14. L.G. Williams. "Dominant planktonic rotifers of major waterways of the United States." Limnol. Oceanogr. 11 (1) (1966): 83-91.

15. H.B.N. Hynes. The Ecology of Running Waters. Toronto: University of Toronto Press, 1972.

16. R.B. Clarkson and J.A. Moore. "Vascular Aquatic Plants in Acid Mine Water of the Monongahela River, West Virginia." Bulletin No.2 Water Research Institute, West Virginia University. Morgantown, West Virginia, 1971.

17. University of Pittsburgh, Graduate School of Public Health and Department of Biology. "A Limnological Study of the Upper Ohio River." Progress Report AT (30-1) 2411 to the Atomic Energy Commission for Period of June 1, 1960 - February 28, 1961. Pittsburgh, PA, 1961.

18. W.T. Mason Jr., P.A. Lewis, and J.B. Anderson. "Macroinvertebrate Collections and Water Quality Monitoring in the Ohio River Basin 1963-67." Analytical Quality Control Laboratory, U.S. EPA, Cincinnati, Ohio, 1971.

19. Federal Water Pollution Control Administration. "Benthic Biology of the Monongahela River Basin - Pennsylvania, West Virginia, Maryland". Work Document No. 16. Ohio River Basin Project, Wheeling, West VA, 1968.

20. B.W. Everman and C.H. Bollman. "Notes on a Collection of Fishes from the Monongahela River." Ann. N.Y. Acad. Sci., 3:335-350, 1886.

21. Pennsylvania Department of Environmental Resources. "State Water Plan -Sub-basin #19 (draft copy)." Harrisburg, PA, 1977.

22. Pennsylvania Department of Environmental Resources, Bureau of Water Quality Management. "Proposals for Recommended Revisions to Water Quality Criteria Wastewater Treatment Regulations, and Industrial Wastes." Pennsylvania Bulletin, 8(9), Harrisburg, PA, 1978.

23. U.S. Army Corps of Engineers, Pittsburgh District. "Allegheny River Navigation Projects Water Quality Report - 1978" (draft material). Pittsburgh, 1978.

24. U.S. Army Corps of Engineers Pittsburgh District. "Commercial Sand and Gravel Dreding in the Allegheny River (mile 0 to Mile 72) Final Environmental Statement". Pittsburgh, PA, 1977.

25. M. Koryak, "Emergent Aquatic Plants in the Upper Ohio River and Major Navigable Tributaries, West Virginia and Pennsylvania" Castanea (in print), 1978.

26. Federal Water Pollution Control Administration. "Benthic Biology Allegheny River Basin. New York, Pennsylvania." Work Document No. 27, Aquatic Biology Unit, Wheeling, West Virginia, 1969.

27. Indiana University, Ohio State University, and Purdue University "Preliminary Technology Assessment Report for the Ohio River Basin Energy Study" Vol. II-A Part I. Prepared for US EPA Office

Energy, Minerals and Industry, Washington, D.C., 1977.

28. R.T. Hartman. "Composition and Distribution of Phytoplankton Communities in the Upper Ohio River." In: Studies on the Aquatic Ecology of the Upper River System. C.A. Tryon Jr., R.T. Hartman, and K.W. Cummins (eds.), Spec. Publ. No. 3, Pymatuning Laboratory of Ecology,Linesville PA, 1965.

29. U.S. Army Corps of Engineers Pittsburgh District. "An Evaluation of the Effects of Mainstem Navigation Dams on the Water Quality of the Upper Ohio River". Pittsburgh, PA, 1975.

30. Duquesne Light Company, Ohio Edison Company, and Pennsylvania Power and Light Company. "Final Environmental Statement Related to the Beaver Valley Power Station Unit 1." U.S. Atomic Energy Commission, Directorate of Licensing. Docket No. 50-334. Washington, D.C. 1973.

31. U.S. Army Corps of Engineers Pittsburgh District Office, Private Communication, October 18, 1978.

32. H.R. Preston and G.E. White. "Summary of Ohio River Fishery Surveys, 1960-76." EPA 903/9-78-009. U.S. Environmental Protection Agency, Region III, Philadelphia, PA, 1978.

33. Pennsylvania Department of Environmental Resources. "State Water Plan Sub-Basin #20 (draft copy)". Harrisburg, PA, 1977.

34. Green International Inc. "Comprehensive Water Quality Management Plan, Study Area #9, Chapter IV, Appendix A" (Prelim. draft copy). Report prepared for Commonwealth of Pennsylvania, Dept. Environ. Resources. Sewickley, Pa., 1976.

35. Green International, Inc. "Comprehensive Water Quality Management Plan, Study Area #8, Chapter IV, Appendix A" (Prelim. draft copy). Report prepared for Commonwealth of Pennsylvania, Dept. Environ. Resources. Sewickley, Pa., 1976.

2.2 Socio-Economic Characteristics

2.2.1 DEMOGRAPHIC COMPOSITION

Nineteen Western Pennsylvania counties are in the Ohio River Basin Energy Study (ORBES) region. Figures 2.2.1-1a and 2.2.1-1b indicate the Pennsylvania Counties included in ORBES and the percent population change by county for 1960-1970 and 1970-1975 respectively. Table 2.2.1-1 presents the county level population in the Pennsylvania ORBES region for 1960, 1970, and 1975. The population has declined in both absolute and relative terms. The percent of the Commonwealth of Pennsylvania population residing in ORBES counties was 32.5% in 1960, 31.0% in 1970 and 30.0% in 1975. The Pennsylvania population for these years was 11,319,366; 11,793,909 and 11,829,000 (estimate).

Considerable variation in population change by county is evident during the 1960-1970 and 1970-1975 periods. Twelve of the nineteen ORBES counties declined in population between 1960-1970 while only two counties (Allegheny and Lawrence) continued to decline between 1970-1975. The 1975 figures are estimates and caution must be observed when using the values for measuring population change. The general reversal in county population decline 1970-1975 is however, rather dramatic.

Examination of Table 2.2.1-2 in light of the observations on population change indicates that, in general, the counties having the highest population growth rates are predominantly rural, e.g., Butler (70% rural), Forest (100% rural), Indiana (74% rural), Jefferson (60% rural), etc. Table 2.2.1-2 also indicates that the region has a small black population. The black population within the region is concentrated in Allegheny County which contains 44% of the entire regional population and 76% of the entire non-white population. In general, the more rural counties have lower percentages of non-whites. Allegheny County is the only county that can be considered highly urban and Beaver County (76.0) demonstrated the second highest percent urbanization in 1970.

The age distribution in the ORBES counties, based on the 1970 census, is presented in Table 2.2.1-3a. Comparison with State values requires that some age groups be combined (as indicated). A measure based on the population age distribution but more meaningful than indications of central tendency is the dependency ratio. The dependency ratio is defined as the number of individuals of non-working age per 100 individuals of working age. The total dependency ratio is calculated by combining all individuals 15 years or younger and 65 years or older and dividing by the number of individuals between 15 and 64 years of age. The resulting quotient is multiplied by 100. The aged dependency racio includes only the number of individuals 65 years or older in the numerator.

The dependency ratios for 1950, 1960 and 1970 are presented on Table 2.2.1-3b. The total dependency ratio increased significantly from 1950 to 1960. It can be seen from Table 2.2.1-3b that the aged dependency ratio increased as well (1950-1960) but was not solely responsible for the observed increase in dependency. Thus there could have been a reduction in the work age population or an increase in the young population. The latter possibility appears most reasonable. From 1960 to 1970 the total dependency ratio decreased. The aged ratio shows an increase and although consistent, generally on the order of 1 or 2 persons, does not appear to be of consequence. The net result for the 1960-1970 period is a reduction in the number of younger persons (less than 15 years) in the population. Even though not too significant in absolute numbers, this is true in relative terms.

The aged dependency ratio and its contribution to the total dependency ratio is significant for several reasons. First, when evaluating human resources one must consider the source of people entering the labor market. These individuals will usually be coming from the younger age group. The services and needs related to an elderly population are another consideration. As the proportion of elderly in the population increases the tax and revenue base begins to decline. A final consideration relates to the health and welfare needs of an elderly population, which is more sensitive to environmentally related illnesses, e.g., bronchitus, asthema, as well as the added social stress that results from rapid changes in community structure.

2.2.2 INCOME

Table 2.2.2-1 shows the income trends for Pennsylvania ORBES counties. For 1960 and 1970 Allegheny County had the highest median family income within the region. This is true as well for per capita income in 1969 and 1974. The county did not however have an unusual growth in income relative to the other counties. Somerset County had the highest growth in median family income 1960-1970 (88.3%) and Cambria County was second (80.2%). These two counties also demonstrated the fastest growth in per capita income in 1969-1974. However, Cambria was first (58.4%) and Somerset second (57.1%). The two counties demonstrating the slowest growth were Elk (50.2%) and Armstrong (53.0%) in 1969-1970 median family income. During 1969-1974 Elk (43.8%) and Mercer (44.4%) counties demonstrated the slowest growth rates in per capita income. In absolute terms Fayette and Green Counties demonstrate the lowest income levels in median family income (1970) and per capita income (1969 and 1974). The percent of families below poverty level (in 1970) is highest in Fayette and Greene Counties (17.6% and 17.8% respectively) and lowest in Westmoreland (6.5%), Allegheny (7.1%) and Beaver (7.2%) counties.

The distribution of families within income groups is shown in Table 2.2.2-2. Mean and median family income are also shown. The percent of families belonging to various income classes provides an indication of the income distribution in all counties. Family income has a skewed distribution in all counties. The income curve is skewed toward higher income as evidenced by the median income being less than mean (average) family income. The modal income class is $5,000-$10,000 in all counties.

Nearly 44% of all families in the region reside in Allegheny County and the regional family income distribution is heavily weighted by Allegheny County values. On a regional basis 15% of all families earned more than $15,000 in 1970. Allegheny County had 21% of its families in that category. Mercer and Westmoreland Counties had the next highest proportion of families in the upper income class, 14.4% in each county. Armstrong County had the lowest proportion of families in the greater than $15,000 group (only 6.8%). Greene County (7.2%), Fayette County (7.4%) and Clearfield County (7.6%) had fairly low proportions of families in the upper income bracket.

Some discrepancy is observed if the percent of families below poverty level on Table 2.2.2-1 is compared with the percent of families earning less than $3,000 (Table 2.2.2-2). It would appear that the poverty level was below $3,000 based on the proportion of families in each class. However, eight of the nineteen counties indicate a greater proportion of families below poverty level than below $3,000 income (Clarion, Fayette and Mercer counties are examples). The source of this inconsistency is unknown.

Comparison of family income based on Table 2.2.2-2 is suggested as more reliable than figures related to poverty level.

2.2.3 EMPLOYMENT

A small positive change in the labor force of the region occurred between 1960 and 1970 as shown in Table 2.2.3-1. A slight population decline is observed for the same period. The sex composition of the labor force shows a consistent increase in female participation from approximately 1/4 of the labor force in 1960 to 1/3 in 1970. This entry of females may have contributed to the observed labor force increase within the region. Wide variations in the labor force change during 1969-1970 occurred within the region when examined by county. The range of change in labor force is from -10.3% in Greene County to +14.7% in Butler County. For Fayette, Cambria, Westmoreland, and Indiana Counties the change was -7.2%, -6.1%, +11.2% and +10.2%.

In each of the above counties the change in labor force parallels the population change during the same period. Additionally, the median family income for these counties in 1960 and 1970 shows a pattern similar to other ranking such as population growth. The migration of economically active individuals within the region is probably an important factor accounting for differential patterns of population change by county.

Employment in five categories (mining, construction, manufacturing, utilities and transportation, and services) for 1972-1975 is shown in Table 2.2.3-2. Manufacturing activities employed the largest number of workers in the region, approximately 370,000 in 1972 and 1975. Employment in manufacturing, if considered a measure of productivity, indicates that on a regional basis no growth or decline in production has occurred. On a county level, large relative changes in employment (productivity) can be observed. This appears to indicate that worker migration on an intra-regional basis may be occurring. It is reasonable to presume that a similar redistribution of manufacturing effort is occurring.

Services constitute the second largest employment sector. An employment change from 181,200 in 1972 to 196,000 in 1975 on a region-wide basis is shown. Greene and Cambria are the only counties that experienced an employment decrease in the services sector. Forest County had a 122.2% increase and Somerset, the second highest relative increase, had a 38.7% change. Allegheny County demonstrated an increase of only 6.5%; however, the absolute change was nearly 7500 positions which represent over 50% of all new service employment. On a regional basis, utilities, transportation and construction did not demonstrate a major change in employment. Redistribution of employment within the region is indicated by the percent change by county in conjunction with little observed change in the region as a whole. With the exception of Allegheny County which had a 1402 employment decline in utilities and transport, the number of employees involved is generally much less than 500.

Regional mining employment increased by 20.1% between 1972 (28,278) and 1975 (33,973). Only four counties experienced a decrease in mining employment; Beaver (-10.4%), Elk (-26.5%), Lawrence (-33.7%) and Venango (-15.4%). However, the absolute number of employees involved, 197, is quite small. Of the 197 lost, 131 occurred in Lawrence County alone. The counties demonstrating the most rapid increase in mining employment on a percentage basis are Clarion (56.9%), Jefferson (50.8%), Indiana (31.8%) and Fayette (31.0%). In absolute terms a 55% increase in employment resulted from increases in Washington, Cambria and Indiana Counties alone accounting for 3170 out of 5700 new employees.

Regionally, a 20,521 person increase in employment occurred between 1972 and 1975, a 30% increase. 71% of the increase occurred in the services sector and 28% in the mining sector.

A detailed breakdown of 1970 employment can be found in Tables 2.2.3-3 through 2.2.3-9. Caution should be employed if attempting to use this information for comparison with 1972 and 1975 data because the means of categorizing subclassification of employment into larger sectors is undefined. The value of the 1970 data lies in inter-county comparison of employee distribution on a relative basis. For example, the metal industries employment in Allegheny County compared to the remaining region accounts for 40% of all identified metal industry workers in 1970.

2.2.4 HOUSING

Water service and sewer service provided to the 1970 housing stock in the region and housing age are presented in Table 2.2.4-1. The reported housing stock based on age is not equivalent to that reported by water or sewer service.

Tables 2.2.4-2 and 2.2.4-3 present the housing age and services data. For example, in Table 2.2.4-2 42.3% of all pre-1939 housing is shown to be located in Allegheny County and 52.4% of all housing served by public water supplies is located in Allegheny County. Table 2.2.4-3 presents the proportional (percentage) distribution of all housing units by category (age, water service, sewer service). By way of example, the table indicates that 5.2 percent of all housing units are pre-1939 vintage and all are located in Westmoreland County. Similarly, 43% of all housing is served by public water supply and is located in Allegheny County. In the region, of total housing stock 57% was built prior to 1939 and 14% between 1960 and 1970. Public Water Service is available in 82% of dwelling units and nearly 70% of the houses are connected to Public Sewer Systems.

Table 2.2.4-4 presents information on the plumbing and kitchen facilities available in the region's housing units. The counties with a small number of housing units (and low population) generally have the lowest percent units with complete facilities and occupancy. Forest County exhibits the extreme in the region in all categories presented in Table 2.2.4-4. The county is 100% rural, has the lowest 1970 population (less than 5000) and smallest work force. Many small towns and communities established in Forest County were abandoned when forestry declined in the area. When compared with other counties, Forest County has a higher proportion of elderly in its population and a relatively low proportion of people in the 15-24 year old group. In 1920 Forest County had a population of nearly 7500. Since 1940 it has never been higher than 5800. A similar population pattern exists for Jefferson County, but this county does not present such a dramatic variation from other Pennsylvania ORBES counties. Nearly 50% of the area of Forest County is contained in the Allegheny National Forest. The area is dotted with seasonal cabins used by hunters, campers and other outdoors people. Over 40% of Forest County housing was built between 1960-1970.

Table 2.2.4-5 presents a distribution of housing units in eight rent categories and the median.

Median rent is closely related to median family income in most of the counties, e.g., they change together. Factors other than income do influence rent as can be seen in Forest County where there is an abundance of "excess" housing units. The median rent value appears to be reasonably close to the modal rent class. The model rent class also appears related to family income, as expected.

Based on the data presented in Tables 2.2.4-1 through 2.2.4-5 the overall housing condition in the Pennsylvania ORBES region is characterized by a higher proportion of older vintage, dwellings (> 50% of existing housing is of pre-1939 vintage) and sewer service are related to the degree of urbanization, housing age and family income.

2.2.5 GOVERNMENTAL REVENUES AND EXPENDITURES

Government revenue for the nineteen Pennsylvania ORBES Counties amounted to $312,377,000 in fiscal year 1974. Nearly 63% of the revenue was collected in Allegheny County alone. Allegheny County accounted for over 66% of total region expenditures which were $320,311,000 in 1974. Expenditures on a regional basis exceeded revenue by $7,934,000. In Allegheny County $15,475,000 more was spent than collected by County level government. The distribution and contribution of State and Federal funding to the expenditure categories shown is unknown.

Revenue for fiscal year 1974 represents a 75.7% increase over 1970 (Table 2.2.5-1, not adjusted for inflation). Expenditures of the counties increased only 50.6%, from $212,614,000 in 1970 to $320,311,000 in 1974.

The increase of revenue on a percentage basis ranged from 29.2% in Fayette County to 431.9% in Jefferson County. Excluding these two extreme values, a range from 47.2% (Clearfield County) to 138.3% (Butler County) is observed. Approximately 40% of revenues is obtained from taxes (range 34.8% to 81.5%) and nearly 48% from other sources (range 29.0% to 53.3%) which includes fines, forfeits, State and Federal grants, licenses, permits, county share of liquid fuel tax, and revenue from the use of money and property. Regionally, the remaining 12% of revenue is derived from departmental earnings. There has been a shift in revenue sources for the area. In 1970, 60% of revenues came from taxes and 29% from other sources. Taxes increased nearly 15% during this period, however, the "other" source of revenue increased over 200%.

The distribution of monies into the five categories indicated in Table 2.2.3-1 has changed to some extent over the 1970 to 1974 period. The shift, however, has not been extensive. On a percentage basis, welfare accounted for 18% of expenditures in fiscal year 1974 and 17% in 1970. The "other" category, which includes the cost of tax collection, highways, hospitals, libraries, parks, airports, civil defense, employee benefits, insurance and interest received a 2.5% share increase. General Administration and the Judicial categories had reduced shares while Corrections amounted for 5.6% of expenditures in 1970 and 1974. The "Others" category accounts for about 55% of dollar expenditures. This figure, however, is somewhat misleading. Allegheny County devoted nearly 64% of its expenditures to this category, the next highest figure is 48% in Butler County. Expenditure increases over 1970 ranged from 12% in Clearfield County to 194% in Forest County. As was indicated with revenues, when these extremes are achieved the range becomes significantly reduced, from 29% (Elk County) to 145% (Clarion County).

Municipalities in the Commonwealth of Pennsylvania have the power to levy taxes under Act 511 of 1965. Table 2.2.5-2 presents the number of municipalities in each county, the total tax collections and the sources of taxes collected as a percent of total collections.

Earned income taxes are the major portion of tax collections for municipalities in all counties except Forest County which relies on per capita and Occupational Privilege taxes exclusively. The amount of tax collected is not necessarily related to the number of taxing municipalities as can be seen in Table 2.2.5-2. However, it is closely tied to total revenue as is shown in Table 2.2.5-1. More detailed descriptions of revenue sources are not readily available on a county basis.

A significant portion of local governmental taxes are usually derived from property taxes. Table 2.2.5-3 presents the market value of taxable real property for 1970 and 1974 through 1975. The assessed property values are given as a percent of the market value. The total market value of taxable real property in the Pennsylvania ORBES region was $20,286,609,000 in 1975, an increase of 27% over 1970. Allegheny County once again significantly affects regional values. In 1970 Allegheny County accounted for 48.7% of the total value of taxable real property and 46.6% in 1975. During the 1970-1975 period the market value of property in Allegheny County increased 21.4%. The counties showing the greatest increased growth in property value during 1970-1975 were Forest (45.9%), Jefferson (45.7%), Clarion (45.5%), and Clearfield (43.5%). The slowest increase in property values occurred in the range of 20 to 27 percent and besides Allegheny County (21.4%) included Mercer (20.4%), Greene (21.5%) and Beaver (26.9%) counties. Were Allegheny County to be excluded from regional figures, the overall increase in property values

1970-1975 would be 32%, a figure 18% higher than indicated earlier.

The expenditure of monies by various county services and assistance programs by category is not clearly defined. Some indication of the level of expenditure in specific categories (e.g., education) can be obtained from such tables as 2.2.6-1 - Education Expenditures.

2.2.6 PUBLIC AND PERSONAL SERVICES

Public and Personal Services include the social service functions related to health, education, and welfare. Additional services are the water and sewer services that may be available through public facilities. This section is a discussion of some of the social and physical services that are provided within the ORBES region of Pennsylvania.

Education expenditures on a per-pupil basis are shown for 1971-1972 through 1974-75 fiscal years on Table 2.2.6-1. The State General Fund contribution is also given a per-pupil basis for the same years. The proportion of total expenditures supplied by State General Fund monies for the 1974-75 fiscal year is given on a percentage basis. Statewide, 45% of total per-pupil expenditures in 1974-75 made us of the State supplied monies. On a regional basis Allegheny County stands out as receiving a low proportion of State funds.

Allegheny County consistently received lower per-pupil State funds and made the largest per-pupil expenditures. Beaver and Mercer Counties had the second smallest State share of per-pupil monies, 49.4% each, which is nevertheless above the statewide value. State funds provided the largest proportion of per pupil expenditures in 1975 in Clarion (70.2%), Clearfield (69.3%), Somerset (68.8%) and Jefferson (68.4%) Counties.

In general, there is less than a $362 difference in per-pupil expenditures between counties (the highest ($1,514) and the lowest ($1,152). Table 2.2.6-2 presents the amount of revenue gathered for educational purposes by the counties over the 1971-72 through 1974-75 period and the sum of money provided by the State (the funds upon which the per-pupil revenue, Table 2.2.6-1, were based) for the same years. The sum of these figures indicates total expenditure for education. Comparison of the figures gives an indication, on a county-by-county basis, of the relative contribution by County and State to education and the magnitude of county educational budgets.

Public assistance (welfare) expenditures for fiscal years 1973 and 1976 by county are shown in Table 2.2.6-3. The expenditures are given as a total dollar amount and the cost per capita to provide the funds. The percent of the population receiving public assistance decreased in all counties (except Elk where no change occurred) from 1973 to 1976, an economically optimistic sign. Per capita expenditures represent the amount of money spent for each individual in the county. Thus the per capita expenditures can be considered per capita cost of providing public assistance of the indicated amount. The per capita expenditure when considered in relation to the portion of the population receiving assistance gives an indication of the relative amount of public assistance provided on a county-by-county basis.

The increase in per capita expenditure indicates the assistance recipients are getting increased funds. At the same time the proportion of the population receiving assistance has decreased. All counties except Venango (-33.6% change in per capita expenditures) have increased the dollar amount assistance per recipient since 1973.

The per capita cost of public assistance varies between counties ranging from a high of $161.05 in Venango County to a low of $72.04 in Forest County for fiscal year 1976. Nine of the nineteen counties had a per capita cost greater than $100.00, the average being $137.90, with a mean percent population receiving assistance of 6.0%. The ten remaining counties had an average per capita cost of $77.27 and the mean of the proportion of population on assistance of 3.7% in 1976.

Table 2.2.6-4 presents the county expenditures for three program classes of medical care; medically needy persons, cash assistance grants and school medical care, for the fiscal years 1972-73 and 1975-76. During this four year (1972-1976) period large relative changes in expenditures occurred within each county in each of the three categories shown. The most consistent change has been a decrease in school medical care expenditures in all counties which ranges from -8% (Jefferson County) to -73% (Greene County). In absolute terms the 8% decrease amounted to about $2,000 and the 73% decrease amounted to approximately $5,100. The largest absolute decrease occurred in Allegheny County -63.4% or $65,700. Regionally there was $177,400 less in school medical care expenditures in 1976 than in 1973, a 54.7% reduction.

The expenditures for medically needy persons decreased in only four counties; Cambria (-28.9%), Fayette (-80.9%), Venango (-45.0%) and Washington (-3.4%) Counties. The most dramatic decrease occurred in Fayette County where there was a decrease in expenditures of $7,000,000 over a four year period. Allegheny County had an increase of 73.1% in expenditures which amounted to nearly $18,000,000. The observed net regional increase in expenditures for medically needly persons was $16,000,000. Because the net regional increase was $2,000,000 less than that for Allegheny County alone ($18,000,000) the remaining counties had a decrease in expenditures. However, as a whole the region showed a 20.6% increase in expenditures. A 64.6% increase in region-wide expenditures for cash assistance grants occurred between 1973 and 1976 amounting to a total of $37,835,000.

Allegheny County increased cash assistance expenditures by $16.5 million; 44% of the regional increase. Venango County is the only county which decreased expenditures in cash assistance by 44%, amounting to $985,000. The percent increase in the region for this program class ranged from 237% in Cambria County to 15% Clarion County (with the exclusion of Venango County). The smallest absolute increase was $22,000 in Forest County (65% more than in 1973).

The allocation of funds between the medically needy persons and cash assistance grants may vary depending on the needs of the population served. However, no apparent patern exists. Some counties spend a greater portion of funds on medically needy persons programs (Clarion, Elk, Jefferson, Somerset, Venango), others on cash assistance (Allegheny, Armstrong, Fayette, Greene, and Washington), and still others spend similar amounts on both programs (Beaver, Butler, Cambria, Clearfield, Indiana, etc.).

The number of persons per doctor for 1970-1974 is presented in Table 2.2.6-5. The number of hospital beds per 100,000 population and general hospitals for 1975 are also shown on Table 2.2.6-5. The high concentration of medical services in Allegheny County is quite evident from the number of hospitals and low number of persons per doctor. Approximately 60 percent of region doctors are located in Allegheny County, and approximately 80% of all doctors in the Pennsylvania ORBES region are located in Allegheny and adjacent counties.

Physical services provided in the region are examined in terms of water and sewer service. Table 2.2.6-6 presents information on water utilities and sewer authorities for 1972 and 1975. The number of water utilities increase only by seven from 1972 to 1975 (301 and 308 respectively) throughout the Pennsylvania ORBES region. Although nine counties show a total increase of 15 water utilities, there was a total decline of 8 in five counties. There was only a total net increase of 19 water utilities throughout the Commonwealth of Pennsylvania. There was an increase of 43 sewer authorities with no reduction in the number of authorities in any one county. Regionally, the number of sewer authorities increased from 127 in 1972 to 170 in 1975.

Public water supply was available to 82% of dwellings in the region and 70% of the houses had public sewer connections in 1970 (Table 2.2.4-3). There was minor growth in the number of water and sewer customers between 1972 and 1975. The number of metered water customers increased by 7.7% and the water sold actually decreased by 2.9%. The increase in the number of customers serviced by sewer authorities was less than 0.2% (943 customers). Unique in the area of sewered customers is that some counties show a significant reduction in the number of customers, e.g., 20,632 in Cambria County, 1855 in Greene County, over 4,000 in Indiana County and nearly 3,000 in Westmoreland County.

2.2.7 AGRICULTURE AND NATURAL RESOURCES

The agricultural productivity of the region for 1975 compared with 1971 can be examined in Table 2.2.7-1. The cash receipts for nine categories of agricultural activity are given in dollar amounts and as a percent increase over 1971 cash receipts.

Elk County was the only county in the region to demonstrate a decrease in total cash receipts since 1971 (-84%). The decrease is a result of reduced livestock production in all three livestock categories (meat animals, dairy products, poultry products) over 80%.

The most striking observation is the consistency of the receipts in several categories as a percent of 1971 receipts. Field crops (160%), Forest and Maple products (40%), Meat animals (22%), Dairy products (34%) and Poultry products (70%) show essentially the same percent increase in receipts for each county. It seems reasonable in these instances that productivity did not change between counties on a relative basis but rather the consistency observed has resulted from price increases for the products. All counties had a reduction in government payments (ranging from -96.2% in Elk County to -35.1% in Armstrong County) and still managed to increase cash receipts by more than one-third (excluding Elk and Butler Counties).

Table 2.2.7-2 presents the land use of inventoried land by county for 1968 and 1974. The total number of acres for 1968 and 1974 differ to some degree due to the nature and extent of land use inventories. However, the values are close enough that for practical purposes the land use categories are comparable.

Regionally, the area of forested land remained fairly stable. However, shifts of over 100,000 acres are seen in the three other land uses categories. Greene County alone accounted for a 98,000 acreage increase in 1974 in the "other" category and an 80,000 acre decrease in pasture land. 18,000 acres of pasture land were a decrease in Westmoreland County and an increase in "other" acreage of 63,500.

The 133,400 acre decrease in cropland resulted from decreases of approximately 10,000 acres in Armstrong, Beaver, Butler, and Mercer Counties, 20,000 acres in Greene County and 40,000 in Westmoreland County. Numerous other counties had changes of 5,000 acres or less. The decrease in crop land and the observed increased receipts from field crops supports the supposition that increases in receipts were the result of price increases rather than production increases.

Pennsylvania produced over 3.7 million barrels (42 gallons each) of crude oil in 1970. The ORBES counties produced over 20% of the State total. Thirteen of the nineteen ORBES counties are oil producers with the 1970 output ranging from a low of 227 barrels in Fayette County to a high of 311,121 in Venango County (42% of the total regional 1970 production).

Table 2.2.7-3 presents the crude oil shipments of the ORBES counties for 1970 and the shipments for 1971, 1972, 1973, 1974 and 1975 as a percent of 1970 shipments. The State shipped 3.7 million barrels in 1970 and only 84.2% of this volume in 1975. The 1975 regional contribution was 138.3% of the 1970 regional production, 33.9% of the state 1975 volume.

Six of the oil producing counties increased production consistently during the 1970-1975 period. The ORBES counties have been, overall, increasing regional production and shipment and supplying a greater portion of state crude oil shipments. It should be noted however that 3,000,000 barrels of oil per year are not a critical contribution to the national oil demand.

Figure 2.2.7-1 indicates the types and location of industrial minerals production in the region with the exclusion of mineral fuels. The large number of areas producing minerals for refractory and structural purposes are indicative of the availability of regional resources for local development of industrial activities and the export of materials out of the region.

The Pennsylvania ORBES region contains significant amounts of coal and extensive waterways that can be included in a discussion of natural resources. However, the extensive topics of water and coal are discussed elsewhere in this report and will not be presented here.

2.2.8 SUMMARY, SOCIO-ECONOMIC CHARACTERISTICS

Presentation of socio-economic data on a county level basis is convenient for working within the recognized boundaries of taxing authorities and political subdivisions. However, a significant disadvantage of this is that the characteristics being examined are more meaningfully evaluated on a multi-county or regional basis. Consider the labor market areas in the Pennsylvania ORBES region as shown in Figure 2.2.8-1. Employment and labor availability is best described by the combination of Allegheny, Beaver, Washington and Westmoreland Counties which are within the economic sphere generated by the City of Pittsburgh. Cambria and Somerset Counties are within Johnstown's economic sphere. Not indicated are the economic centers outside of the State boundaries which influence some Pennsylvania ORBES areas. Wheeling and Morgantown, West Virginia and Youngstown, Ohio, have economic and social influence that cross County and State boundaries. Such factors are rarely defined when county level data are examined.

This summary will present an overview of material previously discussed but will do so by addressing "subregions" of the Pennsylvania ORBES region.

Combining county units into subregions based on their similarities may more fully indicate the regional diversity and interrelations that exist from a socio-economic perspective. The tables presented in this section will group counties based on ranges of socio-economic characteristic values.

Selection of one or two measures from each of the preceding topics are sufficient for grouping counties of similar characteristics. The variables were selected to be representative of the category from which chosen and, although possibly not the most reliable index of a category, they appear sufficient for the purpose at hand.

Aged Dependency Ratio as a percent of Total Dependency Ratio for 1970 (Table 2.2.8-1) provides a measure of the proportion of elderly persons in the dependent population. Four counties (Butler, Elk, Beaver and Westmoreland) have a fairly young dependent population. Fayette, Forest, Greene, and Jefferson Counties have a relatively large aged dependent population.

Population Density per square mile is indicated in table 2.2.8-2. The counties in the Pittsburgh area labor market represent four of the six most densely populated counties. The entire northeastern section of the Pennsylvania ORBES region is seen to have low population density. These are the most rural counties as well. The high population densities in Lawrence and Cambria Counties are the result of influences by Youngstown, Ohio and Johnstown, Pennsylvania. New Castle, Pennsylvania in Lawrence County also contributes to the population density.

Median family income for 1970, in $500 intervals, is shown in Table 2.2.8-3. The Pittsburgh area counties constitute four of the eight counties exhibiting the highest median family incomes. The influences of Johnstown in Cambria County, Youngstown, Ohio and New Castle, Pennsylvania in Lawrence

County are again evident. The four county group of Armstrong, Clarion, Indiana and Jefferson form a geographic unit that fall in the same median family income group. Fayette and Greene Counties also form a small contiguous area with similar income characteristics.

Fayette and Greene Counties fall into the same grouping of labor force change 1960-1970 (Table 2.2.8-4) and both demonstrate a labor force loss of greater than 5.0%. Allegheny and Washington Counties had minor labor force losses while Beaver and Westmoreland Counties (in particular) had labor force increases. It can be seen that proximity to Pittsburgh does not necessarily improve employment opportunity nor does nearness to other large labor market areas, e.g., Cambria and Lawrence Counties and their associated labor market areas.

When county percent changes in manufacturing employment 1972-1975 are grouped (Table 2.2.8-5) an interesting observation can be made. Although the overall region demonstrated no difference (see Table 2.2.3-2) in manufacturing employment, a relocation of manufacturing employment does appear to have occurred. The largest increases are in the counties surrounding major economic centers. Note the location of Beaver, Butler, Armstrong, Greene and Venango Counties relative to Allegheny and Westmoreland Counties (Figure 2.2.8-1). It appears that manufacturing activities have become increasingly dispersed into local areas rather than maintaining a centralization of activities.

Table 2.2.8-6 groups counties by the percent of housing built between 1960 and 1970. The groups not only reflect the development of new housing stock but are similar to those groups that would result from an examination of 1960-1970 population growth. Butler, Forest, Westmoreland and Clarion Counties demonstrate the largest proportion of 1960-1970 built county housing and the highest population growth rates during 1960-1970. Butler, Clarion, and Forest Counties also have had the highest percent change in real property market value during the 1970 to 1975 period.

Clearfield, Indiana and Jefferson Counties have similarly demonstrated a rapid increase in taxable real property value (Table 2.2.8-7). The above six counties are all located in the northern half of the Pennsylvania ORBES region. Armstrong, Elk and Venango Counties have lagged somewhat behind in the growth of property value. Fayette County when examined relative to prior "rankings" is unusual. Generally associated with Greene County in most characteristics, Fayette has experienced an increase in property value comparable to Butler and Indiana Counties. The percent population increase 1970-1975 does not appear to be an explanatory variable. Fayette's population increased only 1.25% 1970-75 while Indiana (6.07%), Butler (7.98%) and Somerset (3.56%) had higher percent increases. Allegheny, Greene and Mercer Counties demonstrated the slowest rate of property value increase, all less than 22%.

The amount of public assistance provided within counties varies with income level, support from revenues, and the number of persons in the county. Table 2.2.8-8 groups counties by percent of the population receiving public assistance funds in 1976. Allegheny, Greene and Fayette Counties have the largest percentage of their populations receiving assistance. This reflects the employment level, income distribution and decreased economic development in these counties. Table 2.2.6-3 indicates that all counties (except Elk) have decreased the percentage of persons receiving assistance since 1973, yet the cost of assistance has increased. It is again observed that the counties that border the Pittsburgh area to the north have a more desirable situation in that a smaller proportion of the population received assistance in 1976. Per-pupil expenditures for education and percent of State support are the final categories for which county groupings are defined (Tables 2.2.8-9 and 2.2.8-10). Allegheny County stands alone in terms of high per-pupil expenditure. This may reflect the large number of schools, transportation, and maintenance requirements in the urban area of Pittsburgh.

There is a fairly narrow range of expenditures between counties. Fifteen of the nineteen counties have per-pupil expenditures between $1150 and $1300. Seven of these counties spend less than $1225 per pupil. The state contribution to educational funds is not solely responsible for providing a more equitable amount of expenditure within the region. Many counties with higher per-pupil expenditures receive lower percentages of State support (e.g., Allegheny, Beaver, Mercer, etc.).

Taxes collected under State Act 511 (see Table 2.2.5-2) are used to support educational programs. The amount of State support provided to counties (Table 2.2.8-10) is higher in the counties that, in general, have a lower medical family income and higher reliance on earned income taxation. This is an apparent trend and is not an established rule for predictive purposes.

The large influence that Allegheny County has when regional values and volumes are discussed was indicated previously. Allegheny County contains 44% of the regional population, 62% of all region families which earned more than $15,000 in 1970, 46% of the 1970 labor force, had an increase of 7500 service employees from 1972 to 1975 (representing 50% of the total region increase), and 66% of total regional county government expenditures in 1974. It becomes evident that presentation of absolute values will group counties on the basis of large populations and concentrated activities. Data presented on a strictly percent change basis may be misleading because the rate of change may be large while the volume of change is small (e.g., Forest County). However, the rate of change is an index of improvement or decline of selected characteristics such as labor force and does serve as a useful measure of county progress.

Tables 2.2.8-1 through 2.2.8-10 group counties on the basis of an absolute or percentage change value of the identified variable. The counties have been assigned unweighted rankings for each of the ten variables for which groupings are provided. The result of the rankings is shown on Table 2.2.8-11 and includes a sum of ranks. The order of ranking was arbitrarily performed such that the lower the number the more desirable the characteristic. For example, from Table 2.2.8-1 Elk County was given the rank of 1 because it had the lowest proportion of elderly dependents. Allegheny County received a rank of 1 for population density (Table 2.2.8-2) since increased density appears to indicate better opportunity, more available resources, and a developed economic base.

The qualitative nature of the ranking procedure is evident. No variable was given more weight than another and no county was weighted based on absolute contribution. The result of the ranking procedure can be seen in Figure 2.2.8-2 where the final ranking was used to group counties. Counties were placed in groups of four (three in the final group) solely on the basis of rank. Thus, Group 1 consists of counties ranked 1, 2, 3, 4 (Butler, Beaver, Westmoreland and Indiana) and constitute the counties with the most desirable overall character.

TABLE	SOURCE
2.2.1-1	1977 Pennsylvania Abstracts, Department of Commerce, Commonwealth of PA, 1977, pp. 16 (1977 PA ABST pg. 16)
2.2.1-2	1977 PA, ABST pg. 12-13, 1960 U.S. CENSUS, 1970 U.S. CENSUS*
2.2.1-3a	1970 U.S.CENSUS
2.2.1-3b	1977 PA ABST pg., AREA RESOURCE FILE, BUREAU OF HEALTH MANPOWER U.S. Dept. HEW, 1970 U.S. CENSUS
2.2.2-1	1970 U.S. CENSUS
2.2.2-2	1970 U.S. CENSUS
2.2.3-1	1970 U.S. CENSUS, 1960 U.S. CENSUS
2.2.3-2	1977 data 1974 PA ABST pg. 139, 1975 data 1977 PA ABST p. 129
2.2.3-3 thru 9	1970 U.S. CENSUS
2.2.4-1	1970 U.S. CENSUS
2.2.4-2	1970 U.S. CENSUS
2.2.4-3	1970 U.S. CENSUS
2.2.4-4	1970 U.S. CENSUS
2.2.4-5	1970 U.S. CENSUS
2.2.5-1	1977 PA ABST pg. 288 1974 PA ABST pg. 233
2.2.2-2	1977 PA ABST pg. 261, 262
2.2.5-3	1977 PA ABST pg. 237
2.2.6-1	1977 PA ABST pg. 152, 153
6-2	1977 PA ABST pg. 268, pg. 153
6-3	75-76 data 1977 PA ABST pg. 184 72-73 data 1974 PA ABST pg. 189
2.2.6-4	75-76 data 1977 PA ABST pg. 193, 194 72-73 data 1974 PA ABST pp. 198, 199
2.2.6-5	1977 PA ABST pg. 176, AREA RESOURCE RILE, BUREAU of HEALTH MANPOWER, U.S. Dept. HEW 1975
2.2.6-6	1975 data 1977 PA ABST pg. 349 and 351 1972 data 1974 PA ABST pg. 353, 354
2.2.7-1	1974 data 1977 PA ABST pg. 308 1971 data PA ABST pg. 312

2.2.7-2	1977 PA ABST pg. 320
2.2.7-3	1977 PA ABST pg. 317
2.2.7-1	1977 PA ABST pg. 315
2.2.8-1	1977 PA ABST pg. 127

2.2.8-1 to 2.2.8-11 Data obtained from previous tables

*1960 U.S. CENSUS AND 1970 U.S. CENSUS DATA COMPILED BY S.I. GORDON, DEPT. CITY AND REGIONAL PLANNING, OHIO STATE UNIVERSITY.

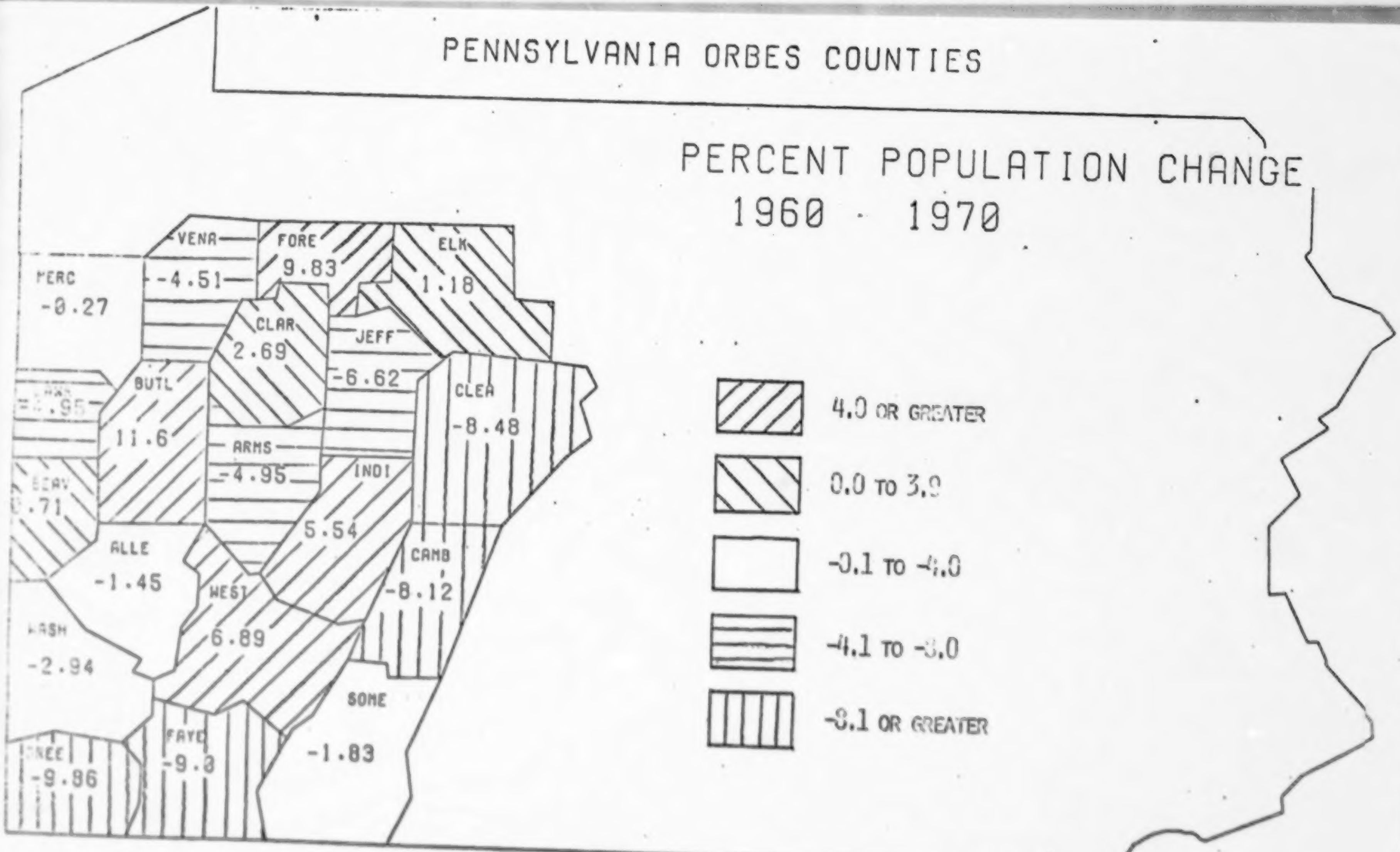

PENNSYLVANIA ORBES COUNTIES
PERCENT POPULATION CHANGE
1960 · 1970
4.0 OR GREATER
0.0 TO 3.9
-0.1 TO -4.0
-4.1 TO -8.0
-8.1 OR GREATER
MERC
-0.27
VENA
-4.51
FORE
9.83
ELK
1.18
CLAR
2.69
JEFF
-6.62
CLEA
-8.48
BUTL
11.6
ARMS
-4.95
INDI
5.54
BEAV
.71
.95
ALLE
-1.45
WEST
6.89
CAMB
-8.12
WASH
-2.94
SOME
-1.83
FAYE
-9.3
GREE
-9.86

FIGURE
2.2.1-1A

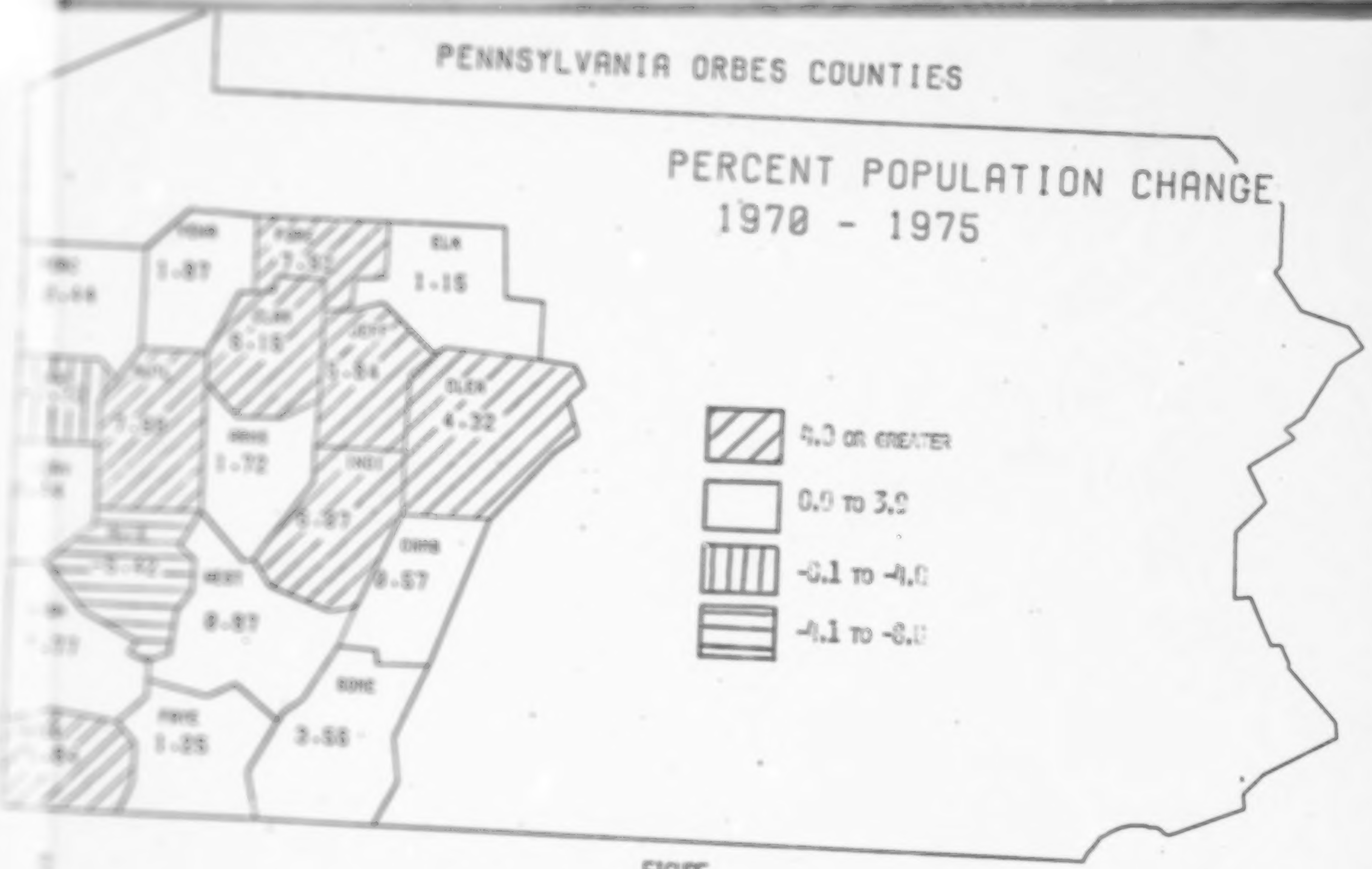

PENNSYLVANIA ORBES COUNTIES
PERCENT POPULATION CHANGE
1970 - 1975
4.0 OR GREATER
0.0 TO 3.9
-0.1 TO -4.0
-4.1 TO -8.0
VENA
1.87
ELK
1.15
CLAR
ARMS
1.72
JEFF
CLEA
4.32
INDI
CAMB
0.57
WEST
0.87
SOME
3.56
FAYE
1.25

FIGURE
2.2.1-1b

TABLE 2.2.1.-1

POPULATION TRENDS 1960 TO 1975
FOR PENNSYLVANIA ORBES COUNTIES AND STATE ORBES TOTALS

County	1960	1970	% Change 60 - 70	1975	% Change 70 - 75
Allegheny	1628587	1605016	- 1.45	1517996	- 5.42
Armstrong	79524	79590	- 4.95	76891	1.72
Beaver	206948	208418	0.71	209328	0.44
Butler	114639	127941	11.60	138152	7.98
Cambria	203283	186785	- 8.12	187851	0.57
Clarion	37408	38414	2.69	40776	6.15
Clearfield	81534	74619	- 8.48	77842	4.32
Elk	37328	37770	1.18	38206	1.15
Fayette	169340	154667	- 9.00	156607	1.25
Forest	4485	4926	9.83	5316	7.92
Greene	39424	36090	- 9.86	38558	6.84
Indiana	75366	79451	5.54	84306	6.07
Jefferson	46792	43695	- 6.62	46245	5.84
Lawrence	112965	107374	- 4.95	106623	- 0.70
Mercer	127519	127175	- 0.27	127741	0.44
Somerset	77450	76037	- 1.83	78746	3.56
Venango	65295	62353	- 4.51	63516	1.87
Washington	217271	210876	- 2.94	214611	1.77
Westmoreland	352629	376935	6.89	380289	0.87
TOTAL	3677787	3634132	- 1.19	3589600	- 1.23
MEAN	193568	191270	- 1.20	188926	- 1.23
MEDIAN	81534	79451	- 2.56	84306	6.11

TABLE 2.2.1.-2

POPULATION CHARACTERISTICS, PENNSYLVANIA ORBES COUNTIES

	1970 Population					1960 Population			
County	Total	% White	% Black	% Urban	% Rural	Total	% Change 50 - 60	% Urban	% Rural (Farm)
Alle	1605016.	90.67	9.19	94.75	5.25	1628587.	7.5	93.2	0.1
Arms	75590.	98.91	1.00	18.49	80.85	79524.	- 1.6	23.2	5.7
Beav	208418.	94.27	5.56	76.59	23.41	206948.	18.1	70.9	1.4
Butl	127941.	99.60	0.34	30.21	69.79	114639.	17.8	29.3	6.0
Camb	186785.	98.03	1.85	58.85	41.15	203283.	- 3.0	60.6	2.2
Clar	38414.	99.77	0.10	15.87	84.13	37408.	- 2.4	13.3	11.7
Clea	74619.	99.67	0.20	28.78	71.22	81534.	- 5.1	28.4	3.5
Elk	37770.	99.91	0.02	47.12	52.88	37328.	8.2	52.0	1.6
Faye	154667.	95.56	4.30	32.81	67.19	169340.	-10.8	30.1	2.7
Fore	4926.	99.15	0.02	0.00	100.00	4485.	- 9.3	- 0.0	7.1
Gree	36090.	98.96	0.93	14.28	85.72	39424.	-13.2	13.2	12.3
Indi	79451.	99.25	0.60	25.82	74.18	75366.	- 2.3	23.8	9.0
Jeff	43695.	99.88	0.07	39.84	60.16	46792.	- 4.8	40.9	8.5
Lawr	107374.	97.28	2.58	52.75	47.25	112965.	7.5	52.6	4.0
Merc	127175.	95.73	4.13	49.83	50.17	127519.	13.9	53.8	6.3
Some	76037.	99.75	0.15	21.68	78.32	77450.	- 5.3	21.0	10.6
Vena	62353.	99.25	0.63	53.37	46.63	65295.	- 0.1	52.1	4.2
Wash	210876.	96.25	3.63	44.02	55.98	217271.	3.6	41.1	3.6
West	376935.	98.23	1.62	59.73	40.27	352629.	12.6	60.7	2.1
PA. ORBES TOTAL	3634132.	94.53	5.33	67.96	32.02	3677787.	5.9	66.9	2.4

TABLE 2.2.1.-3a

[illegible] DISTRIBUTION AS A PERCENT OF COUNTY POPULATION, 1970 CENSUS

	Age Distribution, 5-Year Intervals															
County	<5	5-9	10-14	15-19	20-24	25-29	30-34	35-39	40-44	45-49	50-54	55-59	60-64	65-69	70-74	75+
[illegible]	[illegible]	[illegible]	[illegible]	9.09	7.00	6.01	4.93	5.12	6.50	6.90	6.69	5.97	4.93	3.82	2.97	4.15
[illegible]	[illegible]	[illegible]	[illegible]	8.47	6.06	5.18	4.89	5.00	6.36	6.94	6.42	5.91	4.93	4.14	3.14	4.50
[illegible]	[illegible]	[illegible]	[illegible]	8.45	6.26	5.48	5.16	5.50	6.87	7.12	6.73	5.70	4.36	3.23	2.57	3.59
[illegible]	[illegible]	[illegible]	[illegible]	10.22	7.25	6.06	5.41	5.23	6.16	6.11	5.70	4.86	3.79	2.99	2.46	4.08
[illegible]	[illegible]	[illegible]	[illegible]	10.43	6.10	4.71	4.33	4.74	6.16	6.85	6.86	6.21	4.90	3.78	2.95	4.27
[illegible]	[illegible]	[illegible]	[illegible]	11.74	8.53	5.35	5.30	4.92	5.45	5.66	5.37	4.69	4.31	3.87	3.06	4.51
[illegible]	[illegible]	[illegible]	[illegible]	8.62	5.82	5.52	5.02	4.97	5.91	6.32	6.36	5.63	4.96	4.20	3.41	4.68
[illegible]	[illegible]	[illegible]	[illegible]	8.60	5.97	5.56	5.43	5.32	6.11	6.17	6.00	5.28	4.45	3.42	2.51	3.54
[illegible]	[illegible]	[illegible]	[illegible]	9.36	6.05	4.99	4.55	4.72	6.29	6.75	6.58	5.98	5.15	4.21	3.33	4.85
[illegible]	[illegible]	[illegible]	[illegible]	8.10	4.75	5.38	5.52	4.99	5.26	5.68	5.70	6.09	6.21	5.56	4.09	5.83
[illegible]	[illegible]	[illegible]	[illegible]	10.43	6.79	4.80	4.23	4.52	5.67	6.37	6.40	6.10	5.49	4.33	3.56	5.44
[illegible]	[illegible]	[illegible]	[illegible]	12.66	9.65	5.23	4.75	4.53	5.61	5.68	5.75	5.12	4.23	3.32	2.75	4.29
[illegible]	[illegible]	[illegible]	[illegible]	8.91	5.61	4.90	5.19	5.14	5.93	6.15	6.30	5.90	5.22	4.40	3.90	5.66
[illegible]	[illegible]	[illegible]	[illegible]	10.23	6.90	5.40	4.75	5.19	6.39	6.96	6.57	5.74	4.42	3.54	2.86	4.50
[illegible]	[illegible]	[illegible]	[illegible]	10.41	7.42	5.51	4.81	5.13	6.24	6.52	6.11	5.32	4.35	3.49	2.77	4.28
[illegible]	[illegible]	[illegible]	[illegible]	9.06	6.12	5.25	4.92	5.12	6.24	6.86	6.45	5.92	4.97	3.89	3.25	5.01
[illegible]	[illegible]	[illegible]	[illegible]	9.57	6.30	5.52	5.43	5.42	6.54	6.30	5.95	5.36	4.68	3.65	3.00	4.35
[illegible]	[illegible]	[illegible]	[illegible]	9.48	6.81	5.30	5.08	5.23	6.48	7.05	6.96	6.11	4.75	3.55	2.87	4.28
[illegible]	[illegible]	[illegible]	[illegible]	8.90	6.25	5.67	5.29	5.52	6.80	7.14	6.66	5.74	4.52	3.42	2.64	3.83
[illegible]	[illegible]	[illegible]	[illegible]	9.12	7.23	11.15		11.80		12.85		5.58	4.74	6.70		4.09

DEPENDENCY RATIOS AND POPULATION FOR THE PENNSYLVANIA ORBES COUNTIES, 1950, 1960, and 1970

TABLE 2.2.1.-3b

County	Population (By Year) 1950	Dependency Ratio* 1950		Population (By Year) 1960	Dependency Ratio* 1960		Population 1970	Dependency Ratio* 1970	
		Total	Aged		Total	Aged		Total	Aged
Alle	1515237	47.5	11.7	1628587	63.4	15.7	1605016	58.4	17.3
Arms	80842	59.8	13.9	79524	70.0	17.3	75590	63.5	19.3
Beav	175192	50.1	10.2	206948	65.5	13.7	208418	59.7	15.0
Butl	97320	59.7	15.0	114639	73.0	16.8	127941	64.2	15.7
Camb	209541	56.5	11.6	203283	70.0	16.8	186785	61.9	17.8
Clar	38344	65.8	15.9	37408	72.2	18.8	38414	63.1	18.7
Clea	85957	64.4	15.1	81534	70.6	18.4	74619	69.1	20.8
Elk	34503	57.5	13.7	37328	71.0	15.6	37770	69.8	16.1
Faye	189899	58.7	12.7	169340	71.0	19.0	154667	65.5	20.5
Fore	4944	72.2	19.9	4485	72.7	21.9	4926	73.3	26.8
Gree	45394	61.8	14.0	39424	71.0	20.9	36090	64.5	21.9
Indi	77106	61.6	13.9	75366	69.2	18.1	79451	58.2	16.4
Jeff	49147	62.6	16.9	46792	73.9	21.9	43695	68.8	23.6
Lawr	105120	53.1	13.3	112965	69.5	17.5	107374	59.7	17.4
Merc	111954	56.3	14.7	127519	69.5	16.8	127175	61.8	17.1
Some	81813	61.5	14.5	77450	71.2	19.7	76037	64.2	19.9
Vena	65328	58.9	15.7	65295	70.6	18.6	62353	62.7	17.9
Wash	209628	54.1	13.1	217271	65.3	16.9	210876	58.1	16.9
West	313179	51.7	11.8	352629	65.8	15.6	376935	60.0	15.8

*Total = ≤ 15 yrs. + ≥ 65 ÷ >15 yrs. + < 65 yrs.

Aged = ≥ 65 yrs. ÷ >15 yrs. + < 65 yrs.

TABLE 2.2.2.-1

INCOME TRENDS FOR PENNSYLVANIA ORBES COUNTIES

	MEDIAN FAMILY INCOME 1960	MEDIAN FAMILY INCOME 1970	% CHANGE IN FAMILY MEDIAN INCOME 1960 - 1970	PER CAPITA INCOME 1969	PER CAPITA INCOME 1974	% CHANGE IN PER CAPITA INCOME 1969 - 1974	% FAMILY BELOW POVERTY 1970
ALLEGHENY	6173	10,090	63.5	3321	4924	48.3	7.1
ARMSTRONG	5033	7,702	53.0	2390	3702	54.9	8.8
BEAVER	5777	9,429	63.2	2868	4481	56.2	7.2
BUTLER	5816	9,032	55.3	2604	3854	48.0	8.6
CAMBRIA	4753	8,563	80.2	2540	4024	58.4	9.0
CLARION	4808	7,635	58.9	2308	3527	52.8	13.8
CLEARFIELD	4640	7,489	61.4	2272	3470	52.7	13.8
ELK	5641	8,472	50.2	2454	3529	43.8	7.4
FAYETTE	4295	7,170	66.6	2164	3323	53.6	17.6
FOREST	4641	8,291	78.6	2486	3701	48.9	8.9
GREENE	4441	7,337	65.2	2185	3348	53.2	17.8
INDIANA	4907	7,947	61.9	2391	3630	51.8	11.7
JEFFERSON	4568	7,520	64.6	2370	3565	50.4	13.4
LAWRENCE	5617	8,664	54.2	2605	3809	46.2	9.4
MERCER	5872	9,287	58.2	2733	3947	44.4	7.8
SOMERSET	4056	7,638	88.3	2444	3840	57.1	11.1
VENANGO	5307	8,248	55.4	2481	3767	51.4	10.6
WASHINGTON	5316	8,464	60.9	2650	3992	50.6	9.7
WESTMORELAND	5550	9,213	66.0	2848	4187	47.0	6.5
PA. ORBES COUNTIES							8.5
STATE		9,558		3066	4449	45.1	7.9

TABLE 2.2.2.-2

FAMILY INCOME 1970
INCOME RANGE, PERCENT OF FAMILIES

County	Number of Families	Less than $3,000	3,000-5,000	5,000-10,000	10,000-15,000	Greater than 10,000	Mean	Income Median
Alle	408,693	7.4	7.9	34.2	29.2	21.5	11840	10090
Arm	25,270	9.1	9.9	38.1	36.0	6.8	8531	7702
Beav	54,917	7.6	7.8	40.0	30.4	14.2	10122	9428
Butl	32,812	9.6	7.3	42.1	28.5	12.5	9559	9032
Camb	46,436	9.1	11.6	42.7	25.3	11.4	9503	8563
Clar	9,480	13.5	12.5	45.4	19.6	9.1	8295	7635
Clea	19,441	12.9	12.8	45.0	20.6	7.6	8064	7488
Elk	9,445	7.6	9.4	47.3	26.7	8.9	9087	8472
Faye	39,702	11.6	16.8	44.8	19.4	7.4	7594	7150
Fore	1,280	11.8	5.2	46.5	26.6	10.0	8508	8291
Gree	9,464	17.6	15.1	40.5	19.6	7.2	7589	7337
India	19,785	11.4	12.7	42.7	21.6	11.5	9094	7947
Jeff	10,292	14.8	15.2	51.2	9.7	9.1	8144	7520
Lawr	27,915	9.3	9.4	43.0	26.7	11.1	9254	8664
Merc	31,441	6.2	8.3	41.2	30.0	14.4	9898	9287
Some	19,981	11.6	15.0	42.5	20.2	10.8	8676	7634
Vena	15,305	10.2	10.5	44.9	24.2	10.2	8872	8248
Wash	55,176	9.4	9.5	42.9	25.9	12.3	9243	8664
West	99,572	7.1	9.1	40.3	29.2	14.4	10097	9293
REGION	936,119	8.5	9.4	39.6	27.5	15.0	---	---

TABLE 2.2.3.-1

TRENDS IN LABOR FORCE
PENNSYLVANIA ORBES COUNTIES

County	1960 Labor Force	1970 Labor Force	% Change in Labor Force, 1960-1970	% Male Labor Force 1960	% Male Labor Force 1970	% Female Labor Force 1960	% Female Labor Force 1970	Labor Force 1970 Male	Labor Force 1970 Female
Alle	617985	617086	- 0.15	70	64	30	36	397738	219348
Arm	26287	25999	- 1.1	77	70	23	30	18194	7805
Beav	76176	77734	2.0	75	69	25	31	53260	24474
Butl	39996	45889	14.7	74	68	26	32	31095	14794
Camb	68143	63987	- 6.1	73	65	27	35	41879	22108
Clar	13075	13284	1.6	73	67	27	33	8897	4387
Clear	28618	27323	- 4.5	71	65	29	35	17758	9565
Elk	14129	14738	4.3	69	62	31	38	9194	5544
Faye	53270	49447	- 7.2	73	69	27	31	34075	15372
Fore	1582	1694	7.1	75	69	25	31	1172	522
Gree	12573	11276	-10.3	75	70	25	30	7860	3416
Indi	25605	28219	10.2	72	65	28	35	18247	9972
Jeff	16773	16205	- 3.4	69	65	31	35	10467	5738
Lawr	41076	39888	- 2.9	73	67	27	33	26896	12992
Merc	46941	47360	0.9	73	68	27	32	32036	15324
Some	26525	27843	5.0	71	66	29	34	18288	9555
Vena	22271	21253	- 4.6	70	66	30	34	14027	7226
Wash	76908	76497	- .53	74	68	26	32	52349	24148
West	124602	138572	11.2	74	68	26	32	94597	43975
PA. ORBES TOTAL	1332535	1344294	0.9		66.1		33.9	888029	456265

TABLE 2.2.3.-2

EMPLOYMENT COVERED BY THE UNEMPLOYMENT COMPENSATION LAW
BY INDUSTRY GROUP
PENNSYLVANIA ORBES COUNTIES
1ST QUARTER, 1972, 1975

	Mining			Construction			Manufacturing			Utilities & Transportation			Services		
County	1972	1975	Percent Change	1972	1975	Percent Change	1972	1975	Percent Change	1972	1975	Percent Change	1972	1975	Percen Change
Allegheny	3,070	3,234	5.3	25,244	24,941	- 1.2	164,195	162,187	- 1.2	36,453	35,051	- 3.8	113,810	121,262	6.5
Armstrong	1,879	1,933	2.9	464	399	- 14.0	4,009	4,476	11.6	1,526	1,499	- 1.8	1,550	1,761	13.6
Beaver	268	240	-10.4	1,417	2,291	61.7	37,479	39,752	6.1	1,918	2,644	37.8	6,164	6,727	9.1
Butler	527	623	18.2	1,198	1,293	7.9	13,283	15,167	14.2	1,727	2,042	18.2	3,668	3,981	8.5
Cambria	4,762	6,033	26.7	1,665	1,503	- 9.7	19,674	19,725	0.3	3,063	3,265	6.6	8,833	8,770	- 7.1
Clarion	687	1,078	56.9	275	489	77.8	2,665	2,377	-10.8	758	758	0.0	898	1,061	18.2
Clearfield	1,419	1,807	27.3	664	651	- 1.9	5,906	6,783	14.8	1,443	1,496	3.7	2,280	2,914	27.8
Elk	83	61	-26.5	178	218	22.5	8,306	7,126	-14.2	515	510	- 1.0	1,258	1,514	20.3
Fayette	1,065	1,395	31.0	1,017	826	- 18.8	7,707	7,216	- 6.4	1,952	1,590	-18.5	3,348	3,785	13.1
Forest	6	0	---	27	0	---	515	493	- 4.3	69	55	-20.3	36	80	122.2
Greene	3,139	3,546	13.0	79	186	135.4	736	853	15.9	548	585	6.8	994	966	- 2.8
Indiana	2,453	3,233	31.8	495	658	32.9	5,366	5,459	1.7	1,374	1,549	12.7	1,773	2,271	28.1
Jefferson	413	623	50.8	329	411	24.9	5,386	5,334	- 0.9	497	679	36.6	1,243	1,331	7.1
Lawrence	389	258	-33.7	654	753	15.1	10,387	9,799	- 5.7	1,645	1,549	- 6.0	5,004	5,269	5.3
Mercer	116	127	9.5	928	1,084	16.8	18,323	17,566	- 4.1	2,600	2,658	2.2	5,769	6,260	8.5
Somerset	1,637	2,009	22.7	591	565	- 4.4	3,991	3,465	-13.2	867	922	6.3	1,820	2,525	38.7
Venango	104	88	-15.4	430	456	6.0	7,460	8,213	10.1	1,349	1,253	- 7.1	2,193	2,446	11.5
Washington	4,867	5,991	23.1	3,008	2,624	- 12.8	17,626	18,133	2.9	3,157	2,887	- 8.5	7,199	7,857	9.1
Westmoreland	1,414	1,700	22.4	3,738	3,496	- 6.5	37,164	35,913	- 3.4	5,805	6,043	4.1	13,358	15,176	13.6
	28,278	33,973	20.1	42,401	42,844	1.1	370,178	370,037	- 0.0	67,266	67,032	- 0.4	181,198	195,956	8.2

Reproduced from best available copy.

TABLE 2.2.3-3

1970

EMPLOYMENT CHARACTERISTICS, PENNSYLVANIA ORBES COUNTIES
DURABLE GOODS EMPLOYMENT

NUMBER EMPLOYED IN,

COUNTY	CONSTRUCTION	MANUFACTURING	FURNITURE LUMBER and WOOD PRODUCTS	METAL INDUSTRIES	MACHINERY except ELECTRICAL	ELECTRICAL MACHINERY and SUPPLIES	TRANSPORTATION EQUIPMENT	OTHER DURABLE GOODS
ALLE	30703	162639	1870	71049	15302	14829	5746	17467
ARMS	1395	8781	231	2801	390	245	403	3065
BEAV	3367	35791	177	24923	1485	2883	178	3210
BUTL	2865	15367	214	6364	1501	498	1911	2149
CAMB	2570	20110	269	11499	501	276	1164	1142
CLAR	918	3790	258	226	219	83	355	1843
CLEA	2080	7874	395	485	435	676	219	2223
ELK	473	7886	248	1552	151	4129	25	675
FAYE	3117	13777	740	4801	457	320	850	3161
FORE	118	648	82	136	38	5	7	278
GREE	1063	1506	65	224	86	87	112	156
INDI	2061	6523	377	2008	868	89	79	1203
JEFF	1167	5260	187	265	372	757	82	2400
LAWR	1638	14654	123	6207	2656	230	897	2917
MERC	1621	13438	297	7945	1414	5082	2376	1330
SOME	[illegible]	7262	614	2013	252	111	153	606
VENA	1158	7568	204	1554	3288	117	149	688
WASH	6314	20832	226	11438	1562	3434	286	4171
WEST	6767	52757	586	20732	6770	6407	1909	8501
TOTAL	70253	416556	7163	176222	37747	40258	16901	57185
MEAN	3697	21924	377	9275	1987	2119	890	3010
MEDIAN	2061	8781	248	2801	501	320	286	2149

TABLE 2.2.3-4

EMPLOYMENT CHARACTERISTICS, PENNSYLVANIA ORBES COUNTIES
NUMBER OF CRAFTSMEN, FOREMEN, and KINDRED WORKERS

COUNTY	CRAFTSMEN FOREMEN and KINDRED WORKERS	AUTO-BODY and AUTO-MECHANIC WORKERS	MECHANICS and REPAIR: NON-AUTO	METAL CRAFTS except AUTO	CONSTRUCTION CRAFTSMEN	OTHER CRAFTSMEN
ALLE	84142	6352	11290	10861	19889	35750
ARMS	4141	322	587	521	1126	1585
BEAV	15183	769	1589	2717	3104	7004
BUTL	7913	598	1207	875	2283	2950
CAMB	10384	687	1484	1281	2098	2934
CLAR	2067	249	269	104	660	785
CLEA	4295	415	604	356	1346	1574
ELK	2516	121	287	716	365	1027
FAYE	8469	740	1396	822	2199	3312
FORE	259	18	39	34	64	104
GREE	2181	150	407	94	619	911
INDI	4174	390	639	306	1169	1670
JEFF	2892	245	435	339	781	1092
LAWR	7076	503	826	1428	1425	2894
MERC	7660	614	930	1421	1691	3004
SOME	4415	596	550	315	1384	1570
VENA	3629	290	499	620	754	1466
WASH	13260	1014	2182	1851	3167	5046
WEST	22260	1939	2819	3944	5041	8517
TOTAL	206916	16012	28039	28605	49165	83095
MEAN	10890	843	1476	1506	2588	4373
MEDIAN	4415	503	639	716	1384	1670

TABLE 2.2.3-5

EMPLOYMENT CHARACTERISTICS, PENNSYLVANIA ORBES COUNTIES
MANAGEMENT, ADMINISTRATION, and SALES

NUMBER EMPLOYED IN,

COUNTY	TOTAL MANAGERS and ADMINISTRATORS except FARM	MANAGERS and ADMINISTRATION					SALES WORKERS		
		SALARIED in MANUFACTURING	SALARIED: RETAIL	SALARIED: other INDUSTRIES	SELF-EMPLOYED: RETAIL	SELF-EMPLOYED: OTHER	TOTAL	RETAIL	OTHER
ALLE	46453	9104	8974	22133	3236	3006	51165	29333	21832
ARMS	1211	123	243	501	192	152	1401	1083	318
BEAV	3782	656	754	1597	499	276	4567	3445	1122
BUTL	2715	466	543	1253	192	261	2675	1701	974
CAMB	3601	290	756	1668	546	341	4219	2853	1366
CLAR	746	60	134	304	157	91	762	572	190
CLEA	1800	187	399	801	246	167	1496	1011	485
ELK	738	182	128	190	150	88	790	550	240
FAYE	2843	172	568	1418	442	243	2807	1975	832
FORE	117	15	8	74	0	20	84	59	25
GREE	707	51	115	347	116	78	540	380	160
INDI	1579	143	356	689	264	127	1641	1192	449
JEFF	940	106	128	407	193	106	865	565	300
LAWR	2276	278	503	1007	234	254	2373	1591	782
MERC	2820	403	684	1085	356	292	2784	1905	879
SOME	1523	147	245	675	254	202	1513	1061	452
VENA	1287	269	260	556	87	115	1148	688	460
WASH	4868	754	1093	2018	563	440	4591	3076	1515
WEST	8225	1535	1631	3250	983	826	8862	5925	2937
TOTAL	88212	14941	17522	38263	8710	7085	94283	58965	35318
MEAN	4644	786	922	2014	458	373	4962	3103	1859
MEDIAN	1800	187	399	801	246	202	1641	1192	485

1970

TABLE 2.3.3-6

EMPLOYMENT CHARACTERISTICS, PENNSYLVANIA ORBES COUNTIES
SERVICES EMPLOYMENT

NUMBER EMPLOYED IN,

COUNTY	RAILROAD and RAILROAD EXPRESS	TRUCKING and WAREHOUSING	OTHER TRANSPORTATION	COMMUNICATIONS	UTILITY and SANITARY SERVICES
ALLE	8471	8593	8097	8182	9493
ARMS	226	499	140	305	641
BEAV	1799	927	908	475	1025
BUTL	358	963	345	497	661
CAMB	1451	724	308	604	1219
CLAR	167	269	75	84	238
CLEA	418	521	163	247	450
ELK	71	110	42	120	236
FAYE	1709	605	494	411	1095
FORE	6	20	26	0	54
GREE	14	64	116	149	497
INDI	306	296	176	183	621
JEFF	497	262	101	124	215
LAWR	812	848	232	457	810
MERC	845	527	327	223	497
SOME	367	679	171	281	362
VENA	211	409	90	269	498
WASH	744	1059	761	664	1502
WEST	1153	2500	1005	1483	2637
TOTAL	19626	19875	13577	14758	22751
MEAN	1033	1046	715	777	1197
MEDIAN	418	527	176	281	621

1970

TABLE 2.2.3-7

EMPLOYMENT CHARACTERISTICS, PENNSYLVANIA ORBES COUNTIES
TRADE and FINANCE EMPLOYMENT

NUMBER EMPLOYED IN,

COUNTY	WHOLESALE TRADE	FOOD BAKERY DAIRY STORES	EATING and DRINKING PLACES	GENERAL MERCHANDISE: RETAIL	MOTOR VEHICLE RETAIL SERVICE	OTHER RETAIL TRADE	BANKING and CREDIT INSTITUTIONS	REAL ESTATE and other FINANCE
ALLE	27919	16655	18333	22723	10591	32028	11909	19907
ARMS	428	762	590	512	588	1241	228	256
BEAV	1273	1989	1948	2284	1365	3025	858	914
BUTL	1308	1132	1024	1015	1137	1977	536	859
CAMB	1660	2015	1417	2147	1529	2859	745	886
CLAR	284	411	280	204	364	711	159	126
CLEA	756	833	454	572	743	1388	295	413
ELK	160	306	245	240	194	753	114	156
FAYE	1211	1510	1285	1157	1367	2372	628	745
FORE	26	28	45	57	32	84	22	0
GREE	99	327	164	118	336	474	166	93
INDI	520	849	805	747	644	1324	263	330
JEFF	608	438	390	204	352	750	158	197
LAWR	828	1265	908	941	885	2037	409	934
MERC	1132	1265	1215	1151	1262	2382	519	595
SOME	636	761	658	604	763	1165	291	391
VENA	329	585	359	379	437	954	355	456
WASH	1786	2145	2084	2015	1725	3639	783	1337
WEST	2612	4115	3617	3501	3098	6179	1413	2199
TOTAL	44385	37451	35821	40571	27412	65342	19851	30794
MEAN	2336	1971	1885	2135	1443	3439	1045	1621
MEDIAN	756	849	805	747	763	1388	355	456

TABLE 2.2.3-8

EMPLOYMENT CHARACTERISTICS, PENNSYLVANIA ORBES COUNTIES
PROFESSIONAL, TECHNICAL and KINDRED EMPLOYMENT

NUMBER EMPLOYED IN,

COUNTY	TOTAL	ENGINEERING	PHYSICIANS DENTISTS and RELATED	HEALTH WORKERS except PRACTITIONERS	TEACHERS SECONDARY and ELEMENTARY	TECHNICIANS except HEALTH	OTHER PROFESSIONAL
ALLE	100862	13504	5446	11827	18142	10098	41845
ARMS	2519	148	65	348	836	380	742
BEAV	8752	1151	371	1215	2326	987	2702
BUTL	5854	399	213	833	1664	653	2092
CAMB	7020	616	372	1221	2235	489	2087
CLAR	1464	39	51	96	526	106	646
CLAE	2393	203	115	310	713	281	771
ELK	1711	250	71	279	394	284	433
FAYE	4569	286	179	616	1743	418	1327
FORE	91	0	5	0	36	0	50
GREE	1114	42	49	159	376	33	455
INDI	3484	244	79	419	981	307	1454
JEFF	1429	88	49	169	482	116	525
LAWR	4168	283	222	659	1286	314	1404
MERC	5878	623	278	731	1716	622	1908
SOME	2345	102	119	380	926	197	621
VENA	2494	199	95	451	706	292	751
WASH	8629	676	337	1184	2438	909	3085
WEST	19064	2614	634	2441	4803	2800	5772
TOTAL	183840	21467	8750	23338	42329	19286	6870
MEAN	9676	1130	461	1228	2228	1015	3614
MEDIAN	3484	250	119	451	981	314	1327

TABLE 2.2.3-9

1970

EMPLOYMENT CHARACTERISTICS, PENNSYLVANIA ORBES COUNTIES
NON-DURABLE GOODS EMPLOYMENT

NUMBER EMPLOYED IN,

COUNTY	FOOD and KINDRED PRODUCTS	TEXTILES and FABRICATED TEXTILE PRODUCTS	PRINTING PUBLISHING and ALLIED INDUSTRIES	CHEMICALS and ALLIED PRODUCTS	OTHER NON-DURABLE GOODS
ALLE	10906	1567	8207	6189	9507
ARMS	355	343	132	339	477
BEAV	457	205	488	1167	618
BUTL	361	355	303	382	1349
CAMB	703	3273	459	101	723
CLAR	223	28	58	63	434
CLEA	465	1479	164	34	1299
ELK	70	5	48	156	825
FAYE	399	1529	290	281	349
FORE	0	7	5	5	81
GREE	62	372	123	21	197
INDI	177	640	230	53	799
JEFF	100	361	130	72	533
LAWR	398	221	285	165	555
MERC	303	40	225	86	340
SOME	519	2308	178	47	461
VENA	99	63	362	88	1056
WASH	625	664	493	624	1279
WEST	1465	1129	1343	786	3129
TOTAL	17687	14589	13523	10659	24011
MEAN	931	767	711	561	1263
MEDIAN	361	361	230	101	618

TABLE 2.2.4.-1

HOUSING CHARACTERISTICS, PENNSYLVANIA ORBES COUNTIES

	Year Built				Water Service			Sewer Service		
County	Pre 39	1940-49	1950-59	1960-70	Public	Well	Other	Public	Septic Tank	Other
Alle	291827	66580	102203	72579	512509	17555	3057	486058	43981	3082
Arms	16807	2153	3636	3104	13319	10104	2261	8984	14508	2192
Beav	32440	9907	14503	9092	52526	12240	1144	44055	20765	1090
Butl	19645	3803	7732	8369	18098	19114	2359	15471	22575	1525
Camb	39357	5758	8764	4781	51689	5105	1856	42531	13697	2422
Clar	8122	999	1383	2103	5719	4990	1887	4187	7290	1119
Clea	18906	1769	2781	2426	17372	6552	1971	11836	11201	2858
Elk	7358	1047	2087	1619	9328	2082	719	7272	4080	777
Faye	36549	4407	5815	5107	40465	7929	3451	22802	23689	5374
Fore	1333	338	1117	1905	1306	1631	1796	390	2200	2143
Gree	8888	1468	1055	1092	7514	3581	1409	4632	5872	2000
Indi	15361	1778	2828	3890	13282	8587	2483	9429	12699	2244
Jeff	11918	813	1589	1416	9214	4658	1854	7452	7218	1056
Lawr	21170	2835	5818	4089	24581	9290	558	18626	15149	654
Merc	23308	3732	7045	5945	25629	13406	990	25307	13875	843
Some	16510	2510	3131	3294	15373	6737	3315	9645	13285	2495
Vena	14807	1325	2118	2369	12851	6025	1771	12084	6996	1567
Wash	42652	5337	10630	10414	52209	12130	4691	34758	30887	3385
West	62147	11673	25522	23094	96059	19209	5109	65933	50324	4120
TOTAL	689605	128232	209757	166708	979063	170925	42681	831452	320291	40946
MEAN	36295	6749	11039	8774	51530	8996	2246	43760	16857	2155
MEDIAN	18906	2510	3636	3890	17372	7929	1887	12084	13697	2143

TABLE 2.2.4.-2

HOUSING CHARACTERISTICS, PENNSYLVANIA ORBES COUNTIES

	Year Built				Water Service			Sewer Service		
County	Pre 39	1940-49	1950-59	1960-70	Public	Well	Other	Public	Septic	Other
Alle	42.32	51.92	48.72	43.54	52.35	10.27	7.16	58.46	13.73	7.53
Arms	2.44	1.68	1.73	1.86	1.36	5.91	5.30	1.08	4.53	5.35
Beav	4.70	7.73	6.91	5.45	5.36	7.16	2.68	5.30	6.48	2.66
Butl	2.85	2.97	3.69	5.02	1.85	11.18	5.53	1.86	7.05	3.72
Camb	5.71	4.49	4.18	2.87	5.28	2.99	4.35	5.12	4.28	5.92
Clar	1.18	0.78	0.66	1.26	0.58	2.92	4.42	0.50	2.28	2.73
Clea	2.74	1.38	1.33	1.46	1.77	3.83	4.62	1.42	3.50	6.98
Elk	1.07	0.82	0.99	0.97	0.95	1.22	1.68	0.87	1.27	1.90
Faye	5.30	3.44	2.77	3.06	4.14	4.64	8.09	2.74	7.40	13.12
Fore	0.19	0.26	0.53	1.14	0.13	0.95	4.21	0.05	0.69	5.23
Gree	1.29	1.14	0.50	0.66	0.77	2.10	3.30	0.56	1.83	4.88
Indi	2.30	1.39	1.35	2.33	1.36	5.02	5.82	1.13	3.96	5.48
Jeff	1.73	0.63	0.76	0.85	0.94	2.73	4.34	0.90	2.25	2.58
Lawr	3.07	2.21	2.77	2.45	2.51	5.44	1.31	2.24	4.73	1.60
Merc	3.38	2.91	3.36	3.57	2.62	7.84	2.32	3.04	4.33	2.06
Some	2.39	1.96	1.49	1.98	1.57	3.94	7.77	1.16	4.15	6.09
Vena	2.15	1.03	1.01	1.43	1.31	3.52	4.15	1.45	2.18	3.83
Wash	6.18	4.16	5.07	6.25	5.33	7.10	10.99	4.18	9.64	8.27
West	9.01	9.10	12.17	13.85	9.81	11.24	11.97	7.93	15.71	10.06

*Presented as percent of column totals

Total 2.2.4 - 3

Housing Characteristics, Pennsylvania ORBES Counties

County	Year Built				Water Service			Sewer Service		
	Pre 39	1940-49	1950-59	1960-70	Public	Well	Other	Public	Septic	Other
Alle	24.43	5.57	8.56	6.08	42.97	1.47	0.26	40.75	3.69	0.26
Arms	1.41	0.18	0.30	0.26	1.12	0.85	0.19	0.75	1.22	0.18
Beav	2.72	0.83	1.21	0.76	4.40	1.03	0.10	3.69	1.74	0.09
Butl	1.64	0.32	0.65	0.70	1.52	1.60	0.20	1.30	1.89	0.13
Camb	3.30	0.48	0.73	0.40	4.33	0.43	0.16	3.57	1.15	0.20
Clar	0.68	0.08	0.12	0.18	0.48	0.42	0.16	0.35	0.61	0.09
Clea	1.58	0.15	0.23	0.20	1.46	0.55	0.17	0.99	0.94	0.24
Elk	0.62	0.09	0.17	0.14	0.78	0.17	0.06	0.61	0.34	0.07
Faye	3.06	0.37	0.49	0.43	3.39	0.66	0.29	1.91	1.99	0.45
Fore	0.11	0.03	0.09	0.16	0.11	0.14	0.15	0.03	0.18	0.18
Gree	0.74	0.12	0.09	0.09	0.63	0.30	0.12	0.39	0.49	0.17
Indi	1.33	0.15	0.24	0.33	1.11	0.72	0.21	0.79	1.06	0.19
Jeff	1.00	0.07	0.13	0.12	0.77	0.39	0.16	0.62	0.61	0.09
Lawr	1.77	0.24	0.49	0.34	2.06	0.78	0.05	1.56	1.27	0.05
Merc	1.95	0.31	0.59	0.50	2.15	1.12	0.08	2.12	1.16	0.07
Some	1.38	0.21	0.26	0.28	1.29	0.56	0.28	0.81	1.11	0.21
Vena	1.24	0.11	0.18	0.20	1.08	0.51	0.15	1.01	0.59	0.13
Wash	3.57	0.45	0.89	0.87	4.38	1.02	0.39	2.91	2.59	0.28
West	5.20	0.98	2.14	1.93	8.05	1.61	0.43	5.53	4.22	0.35
Total	57.74	10.73	17.56	13.96	82.04	14.33	3.58	69.71	26.85	3.43

* Presented as per cent
of total units in each
of the three categories.

TABLE 2.2.4-4
HOUSING FACILITIES, PENNSYLVANIA ORBES COUNTIES

			Plumbing, %Units				Kitchen %		
	Total Year Round Units	Percent Occupied	All Facilities	Lack Some	Lack Hot	Lack Other	Exclusive Use	Share dose	Incomplete Facilities
Allegheny	533,196	96.0	96.0	4.0	0.4	3.6	98.2	0.3	1.5
Armstrong	25,614	94.4	90.3	10.1	0.4	9.6	95.8	0.1	4.4
Beaver	65,930	97.2	96.4	3.6	0.6	3.1	98.2	0.1	1.7
Butler	39,453	94.4	94.9	5.4	0.3	5.1	97.2	0.1	3.0
Cambria	58,641	96.5	91.8	8.2	1.3	6.9	96.9	0.1	3.0
Clarion	12,588	91.1	88.8	11.3	0.9	10.4	94.3	0.2	5.7
Clearfield	25,939	91.4	95.6	14.2	1.7	12.5	94.0	0.0	5.7
Elk	12,090	92.0	92.9	7.4	0.2	7.2	95.4	0.0	4.8
Fayette	51,846	94.7	86.8	13.3	0.9	12.3	95.1	0.1	4.9
Forest	3,893	41.4	61.2	59.4	1.0	58.4	76.7	0.0	43.9
Greene	12,512	92.6	83.2	16.7	0.2	16.5	90.4	0.0	9.5
Indiana	24,354	94.1	87.1	13.0	1.0	12.0	94.9	0.0	5.0
Jefferson	15,698	91.3	90.1	10.2	0.8	9.4	94.3	0.0	5.9
Lawrence	34,399	96.1	96.4	3.8	0.2	3.5	97.6	0.1	2.5
Mercer	39,399	96.0	96.0	4.1	0.2	3.8	97.9	0.0	2.1
Somerset	25,374	95.0	88.3	11.9	1.4	10.5	95.6	0.1	4.5
Venango	20,428	92.0	93.8	7.2	0.7	6.5	97.4	0.1	3.6
Washington	69,045	95.8	93.1	6.9	0.6	6.2	97.1	0.1	2.8
Westmoreland	120,262	96.8	95.2	5.0	0.5	4.4	98.3	0.1	1.8
PA ORBES Total	1,191,251	95.5	94.0	6.1	0.5	5.6	97.4	0.2	2.6

TABLE 2.2.4-5

Housing Characteristics, Pennsylvania ORBES Counties

County	Less Than $30	$30-39	$40-59	$60-79	$80-99	$100-149	$150-199	$200+	Median Rent	MEDIAN FAMILY INCOME
	Housing Units, Rental Cost									
Alle	716	4,212	15,174	29,668	36,071	52,443	22,305	10,879	100	10,090
Arms	142	272	1,055	1,703	1,161	766	81	27	73	7,702
Beav	103	519	1,513	3,290	4,190	4,152	757	140	88	9,428
Butl	57	328	685	1,578	1,683	2,123	646	110	92	9,032
Camb	252	788	3,042	4,622	3,620	2,540	372	85	76	8,563
Clar	66	66	357	614	493	445	66	19	79	7,635
Clea	121	242	1,051	1,380	1,045	679	85	21	73	7,488
Elk	18	40	269	515	497	462	52	8	83	8,472
Faye	549	714	3,377	4,174	2,410	1,558	264	18	69	7,150
Fore	16	5	50	77	28	29	0	0	68	8,291
Gree	80	185	582	721	398	332	58	10	69	7,337
Indi	148	212	824	1,181	904	1,150	424	135	82	7,947
Jeff	79	145	718	1,070	539	244	35	9	68	7,520
Lawr	119	256	1,119	1,865	1,766	1,588	218	44	81	8,664
Merc	37	118	763	1,661	2,026	2,218	569	110	91	9,287
Some	238	342	1,258	1,452	816	462	74	27	67	7,634
Vena	65	153	588	1,270	1,065	657	143	5	78	8,248
Wash	311	519	2,491	4,600	3,635	3,623	686	138	80	8,664
West	379	757	3,269	6,151	5,893	6,475	1,919	371	86	9,293
Mean	184	520	2,010	3,557	3,592	4,313	1,597	675	79	
Median	119	256	1,051	1,578	1,161	1,150	220	27	79	

Reproduced from best available copy.

TABLE 2.2.5.-1

GOVERNMENT REVENUES AND EXPENDITURES
PENNSYLVANIA ORBES COUNTIES 1974

	REVENUE (x $1000) % OF TOTAL BY SOURCE				EXPENDITURES (x $1000) % OF TOTAL BY CATEGORY						% INCREASE OVER 1970	
	TOTAL	GEN. TAXES	DEPT. EARNINGS	OTHER	TOTAL	GEN. ADMIN.	JUDICIAL	CORRECTIONS	WELFARE	OTHER	REVENUE	EXPEND
ALLEGHENY	196,462	37.4	13.2	49.5	211,937	13.1	5.9	5.9	11.2	63.9	67.4	40.9
ARMSTRONG	3,846	41.3	18.6	40.0	3,241	20.3	8.5	3.1	39.1	29.0	106.3	81.7
BEAVER	16,680	36.3	12.3	51.4	17,363	10.7	11.4	3.6	30.0	44.2	87.5	92.2
BUTLER	7,174	34.8	13.8	51.5	7,393	11.9	9.2	6.2	24.2	48.5	138.3	59.8
CAMBRIA	12,586	41.3	13.0	45.8	11,942	12.3	8.7	4.1	43.5	31.3	116.1	112.7
CLARION	1,334	44.6	21.6	33.8	1,443	18.8	12.3	5.3	28.8	34.7	119.8	144.6
CLEARFIELD	2,884	46.5	12.9	40.6	1,927	25.1	20.6	12.9	20.5	21.0	47.2	12.0
ELK	1,751	49.7	11.0	39.3	1,722	27.1	6.7	5.34	24.2	36.7	78.7	29.2
FAYETTE	5,562	45.2	9.6	45.3	4,867	13.7	18.4	7.5	18.3	42.2	29.2	31.6
FOREST	314	41.1	22.9	36.0	379	46.2	21.1	5.0	3.7	24.0	61.9	193.8
GREENE	3,464	37.4	10.9	51.6	3,444	17.5	7.7	5.8	34.4	34.7	81.2	82.1
INDIANA	3,760	41.7	22.1	36.2	3,811	20.2	8.8	7.9	29.1	33.9	66.8	46.1
JEFFERSON	7,611	81.5	5.1	13.5	2,138	22.8	9.4	3.3	37.3	27.3	431.9	73.8
LAWRENCE	4,402	42.7	10.3	47.0	4,211	17.1	14.7	6.2	19.0	43.1	79.7	61.0
MERCER	6,548	36.0	15.0	49.0	6,956	13.2	11.4	6.6	35.6	33.3	62.6	74.1
SOMERSET	3,370	47.9	23.2	29.0	3,256	26.1	14.2	5.5	35.8	18.5	64.2	66.9
VENANGO	3,206	40.3	26.4	33.3	2,770	17.9	9.8	3.9	44.4	24.0	74.6	48.2
WASHINGTON	10,938	42.8	7.5	49.6	10,633	16.3	12.3	6.9	21.5	43.0	84.0	77.9
WESTMORELAND	20,485	39.0	7.7	53.3	20,878	9.6	10.3	3.5	36.2	40.4	89.1	80.2
TOTAL	312,377	39.4	12.7	47.9	320,311	13.5	7.7	5.6	18.8	55.1	75.7	50.6

TABLE 2.2.5.-2
ACT 511 TAXES COLLECTED BY MUNICIPALITIES $X1,000 1974

	No. of Municipalities	Total	Per Capita	Earned Income	Realty Transfer	Merchantile	Amusement	Occup Priv.	Other
ALLEGHENY	127	44989	0.9	44.4	7.1	6.9	5.8	11.1	23.7
ARMSTRONG	45	665	23	49.6	1.0			14.4	11.9
BEAVER	53	5401	5.8	76.8	5.0	4.5	0.1	6.9	0.7
BUTLER	56	2728	10.5	76.5	4.1	3.0	0.1	5.7	0.1
CAMBRIA	64	3783	6.6	67.6	3.9	9.5	1.1	10.3	0.9
CLARION	34	442	16.3	80.1				3.2	0.4
CLEARFIELD	50	1243	6.2	81.4	3.9			8.4	
ELK	13	424	8.2	58.7				27.4	5.9
FAYETTE	42	1935	5.3	81.4	2.2	4.7	0.5	5.6	0.3
FOREST	9	11	54.5	-				45.5	
GREENE	26	643	6.7	56.5	22.9	2.9		10.9	
INDIANA	38	1192	3.2	77.8	14.2			4.8	0.1
JEFFERSON	34	722	8.7	76.7	3.5		0.1	8.6	2.2
LAWRENCE	26	2033	6.8	69.0	7.5	3.5	0.0	11.8	1.4
MERCER	48	3351	7.2	74.7	7.5		1.2	6.7	2.8
SOMERSET	50	1203	14.3	72.6	7.9	2.0		3.1	
VENANGO	31	989	10.5	60.3	7.6	6.3		17.5	0.9
WASHINGTON	66	4149	7.7	74.7	4.4	3.2		6.8	1.2
WESTMORELAND	64	7754	6.8	73.4	6.3	3.4	0.6	7.4	2.0
PA ORBES TOTAL	876	83657							

TABLE 2.2.5-3

TAXABLE REAL PROPERTY
MARKET AND ASSESSED VALUES 1970-1975
PENNSYLVANIA ORBES COUNTIES

	1970 VALUE		1972 VALUE		1973 VALUE		1974 VALUE		1975 VALUE		% CHANGE MARKET VALUE 1970-1975
	MARKET	ASSESSED	MARKET	ASSESSED	MARKET	ASSESSED	MARKET	ASSESSED	MARKET	ASSESSED	
ALLEGHENY	7,786,969	53.8	8,422,909	55.9	8,601,021	55.7	9,296,416	52.3	9,457,198	52.2	21.4
ARMSTRONG	238,682	31.5	262,857	29.8	271,861	29.7	301,579	27.2	308,750	27.3	29.4
BEAVER	887,663	43.2	987,119	32.3	1,000,304	32.1	1,097,542	29.6	1,126,473	29.3	26.9
BUTLER	484,084	32.3	555,728	34.2	580,073	33.8	661,410	30.6	686,490	30.4	41.8
CAMBRIA	507,635	39.3	552,479	37.1	556,005	44.8	642,040	39.9	671,117	39.5	32.2
CLARION	123,914	26.6	144,094	24.2	149,734	24.0	176,286	21.5	180,320	49.2	45.5
CLEARFIELD	233,597	38.2	265,777	35.6	280,996	35.2	320,370	32.8	335,241	32.3	43.5
ELK	1,335,841	96.0	1,476,041	84.0	1,521,181	83.0	1,673,471	69.0	1,722,271	69.0	28.9
FAYETTE	338,147	41.1	388,144	37.8	397,634	37.6	454,327	33.8	472,842	33.4	39.8
FOREST	25,943	23.4	30,928	21.2	32,255	21.1	36,764	37.7	37,844	37.3	45.9
GREENE	149,884	36.8	163,034	34.8	164,605	34.5	179,308	32.1	181,408	31.8	21.0
INDIANA	240,834	39.3	277,479	35.8	288,938	35.5	324,948	32.6	343,251	32.2	42.5
JEFFERSON	102,011	33.3	116,100	30.7	123,031	30.3	142,035	42.1	148,584	41.4	45.7
LAWRENCE	373,606	34.0	415,136	32.0	424,667	31.9	470,917	39.5	483,056	29.3	29.3
MERCER	529,310	33.4	583,538	31.8	594,676	31.7	638,735	38.5	637,291	38.2	20.4
SOMERSET	229,854	22.8	263,856	21.4	273,114	21.4	302,900	28.7	301,221	28.6	31.0
VENANGO	207,054	32.2	231,147	29.9	238,290	39.6	267,223	27.0	275,566	26.8	33.1
WASHINGTON	755,071	29.9	856,244	27.7	889,448	27.6	980,493	25.6	1,014,423	25.4	34.3
WESTMORELAND	1,433,825	25.5	1,590,744	24.8	1,614,056	24.9	1,847,115	22.1	1,903,263	22.0	32.7
PA. ORBES COUNTIES	15,983,924	48.0	17,583,354	47.2	18,001,889	42.2	19,813,879	43.5	20,286,609	43.5	26.9

Market value x $1,000
Assessed value as % of market value

TABLE 2.2.6.-1

EDUCATION - GENERAL FUND REVENUE AND EXPENDITURES

	County Revenue - Rate Per Pupil $				Total Expenditure Per Pupil				
County	1971-72	1972-73	1973-74	1974-75	1971-72	1972-73	1973-74	1974-75	1975 % From State
Allegheny	$420	$450	$482	$564	1,146	1,261	1,356	1,514	37.2
Armstrong	628	659	718	845	954	1,124	1,165	1,363	62.0
Beaver	476	520	548	629	942	1,045	1,135	1,274	49.4
Butler	510	576	621	686	973	1,022	1,118	1,220	56.2
Cambria	606	657	690	804	988	1,118	1,181	1,333	60.3
Clarion	646	660	737	846	915	999	1,104	1,205	70.2
Clearfield	629	662	724	798	884	976	1,071	1,152	69.3
Elk	460	501	571	704	897	979	1,061	1,211	58.1
Fayette	675	739	802	901	919	1,051	1,103	1,256	71.7
Forest	559	607	643	723	922	1,161	1,181	1,254	57.7
Greene	526	611	652	754	981	1,155	1,163	1,256	60.0
Indiana	568	610	664	746	929	1,036	1,136	1,246	60.0
Jefferson	664	726	761	863	987	1,119	1,170	1,261	68.4
Lawrence	552	604	631	701	933	1,016	1,086	1,227	57.1
Mercer	500	547	585	674	947	1,029	1,160	1,363	49.4
Somerset	601	652	722	810	891	986	1,055	1,178	68.8
Venango	600	658	686	784	981	1,051	1,124	1,260	62.2
Washington	518	551	604	671	937	1,001	1,085	1,221	55.0
Westmoreland	479	535	583	662	933	1,006	1,106	1,216	54.4
PA. STATE	498	536	570	653	1,089	1,176	1,283	1,439	45.4

TABLE 2.2.6- 2

SCHOOL TAXES COLLECTED AND GENERAL FUND REVENUE

	Total School Tax Collected[1] by County Thousands of $				General Fund Revenue from State Sources Thousands of $			
	71-72	72-73	73-74	74-75	71-72	72-73	73-74	74-75
ALLE	201949	208182	220170	229538	122213	130301	133441	151435
ARMS	6839	7163	7667	8036	11678	12049	12916	14799
BEAV	22291	24283	25666	28350	22613	24533	25485	28405
BUTL	13634	14039	14850	15542	15354	17600	18737	20625
CAMB	12280	13284	15704	16579	21710	23115	23918	27169
CLAR	3292	3405	3542	3942	6872	7052	7682	8649
CLEA	6037	6550	7094	8080	13380	14188	15288	16732
ELK	3110	3327	3418	3580	3310	3623	4100	4888
FAYETT	7529	7739	8148	8169	22503	24271	26045	28639
FORE	554	656	670	721	675	713	767	869
GREE	3848	3465	3821	3704	4556	5168	5443	6336
INDI	6478	6893	7199	7478	9900	10584	11509	12963
JEFF	2563	2902	3103	3095	6453	6989	7483	8343
LAW	9353	9685	9931	10282	13576	14577	14799	16000
MERC	13227	13544	14237	15936	15232	16339	17088	19108
SOME	5001	5307	5504	6298	10587	11393	12417	13623
VENA	5808	6112	6407	6891	9892	10764	10974	12135
WASH	18097	19438	20582	22746	24362	35490	27319	30035
WEST	37486	39369	41998	43020	40250	44860	48208	53738
Region	379376	395348	419711	442287	375116	413609	423619	474491
State	1261154	1331832	1427555	1539205	1156109	1241807	1291984	1449164

---

1. includes real estate, per capita, Act 511 taxes, payments in lieu of taxes and delinquent taxes and public utility realty tax (distributed by Commonwealth)

TABLE 2.2.6.-3

PUBLIC ASSISTANCE EXPENDITURES
(Thousands of dollars)

	1972-73			1975-76			1973-76
County	Total	Per Cap.	% Pop.	Total	Per Cap.	% Pop.	Percent Change Per Capita Expenditure
Alle	188,660	117.68	7.5	240,461	156.95	6.9	33.3
Arms	5,829	77.51	6.6	6,370	83.60	4.6	7.8
Beav	13,287	63.64	4.5	16,239	77.62	3.8	22.0
Butl	6,450	49.69	3.6	10,043	74.17	3.4	49.3
Camb	26,193	141.35	5.1	29,041	153.82	3.4	8.8
Clar	2,546	65.96	5.7	2,976	73.30	3.7	11.1
Clea	5,059	68.37	5.3	6,842	89.09	3.9	30.3
Elk	1,489	39.29	2.8	2,556	67.62	2.8	72.1
Faye	21,387	139.51	13.0	22,726	145.40	9.8	4.2
Fore	288	57.60	5.1	353	72.04	4.0	25.1
Green	5,585	156.01	13.5	5,866	158.11	9.4	1.3
Indi	5,972	74.56	5.7	6,052	72.13	3.5	- 3.2
Jeff	3,106	71.57	5.0	3,569	76.92	3.6	7.5
Law	8,684	81.23	6.0	11,971	111.67	5.4	37.5
Merc	8,843	69.47	5.2	13,592	105.53	5.0	51.9
Some	7,178	94.45	6.4	9,593	124.26	4.2	31.6
Vena	15,075	242.75	6.8	10,243	161.05	4.8	-33.6
Wash	22,507	106.92	6.6	26,594	124.45	4.8	16.4
West	24,591	64.63	4.3	32,651	86.26	3.8	33.5
Region	372,729			457,738			22.8*
State	1,264,199	106.42	7.0	1,837,402	155.25	6.5	45.9

*Percent change 1973-1976 Total Regional Expenditures

TABLE 2.2.6.-4

EXPENDITURES FOR MEDICAL CARE BY PROGRAM CLASS
(Thousands of Dollars)

	Medically Needy Persons			Cash Assistance Grants			School Medical Care		
County	1972-73	1975-76	% Increase	1972-73	1975-76	% Increase	1972-73	1975-76	% Increase
Alle	24,497	42,410	73.1	30,980	47,540	53.5	103.7	38.0	-63.4
Arms	580	736	26.9	839	1,276	52.1	7.8	4.2	-46.2
Beav	2,800	2,964	5.9	1,546	3,164	104.7	12.0	5.7	-52.5
Butl	957	2,430	153.9	1,028	2,087	103.0	11.8	3.4	-71.2
Camb	14,526	10,325	- 28.9	3,191	10,772	237.6	22.3	11.5	-48.4
Clar	251	691	175.3	361	415	15.0	6.2	2.9	-53.2
Clea	725	1,635	125.5	881	1,526	73.2	6.9	3.7	-46.4
Elk	284	885	211.6	245	388	58.4	4.6	2.5	-45.7
Faye	8,670	1,655	- 80.9	2,900	3,747	29.2	34.0	16.2	-52.4
Fore	30	34	13.3	34	56	64.7	0.5	0.2	-60.0
Gree	451	605	34.1	790	922	16.7	7.0	1.9	-72.9
Indi	729	1,098	50.6	818	1,168	42.8	9.8	4.7	-52.0
Jeff	528	1,011	91.5	512	616	20.3	2.4	2.2	- 8.3
Lawr	630	2,211	251.0	1,398	2,306	64.9	9.5	8.6	- 9.5
Merc	991	2,898	191.4	1,318	2,279	72.9	9.1	2.9	-68.1
Some	1,560	3,422	119.3	1,473	2,551	73.2	12.5	5.1	-59.2
Vena	9,030	4,971	- 45.0	2,244	1,259	- 43.9	10.9	4.7	-56.9
Wash	5,760	5,565	- 3.4	3,367	7,319	117.4	25.7	13.9	-45.9
West	4,514	7,965	76.5	4,682	7,051	50.6	27.7	14.7	-46.9
TOTAL	77,513	93,511	20.6	58,607	96,442	64.6	324.4	147.0	-54.7
STATE	189,724	372,572	96.4	221,584	383,797	73.2	871.0	511.5	-41.3

TABLE 2.2.6.-5

HEALTH CARE STATISTICS, PENNSYLVANIA ORBES COUNTIES

County	Persons Per Doctor					1975	
	1970	1971	1972	1973	1974	General Hospitals	Beds Per 100,000
Allegheny	571.58	541.73	517.09	505.79	480.43	27	631
Armstrong	2,160.00	2,321.21	2,261.76	2,241.18	2,059.46	1	267
Beaver	1,390.00	1,416.89	1,443.45	1,449.66	1,483.69	4	337
Butler	1,910.45	1,949.25	1,841.67	1,877.78	1,781.58	2	610
Cambria	972.92	958.88	921.84	915.53	890.57	4	695
Clarion	6,383.33	6,616.67	5,742.86	5,757.14	3,690.91	1	170
Clearfield	1,817.07	1,785.71	1,760.47	1,786.05	1,536.00	3	529
Elk	1,570.83	1,465.38	1,469.23	1,473.08	1,350.00	2	955
Fayette	1,778.16	1,746.07	1,660.00	1,657.89	1,628.13	3	365
Forest	1,633.33	1,666.67	1,666.67	1,666.67	1,633.33	---	---
Greene	1,565.22	1,545.83	1,550.00	1,562.50	1,426.92	1	306
Indiana	1,939.02	1,919.05	1,767.39	1,808.70	1,747.92	1	246
Jefferson	1,321.21	1,390.63	1,384.38	1,415.63	1,657.14	2	328
Lawrence	1,396.10	1,419.74	1,405.19	1,401.30	1,276.19	3	501
Mercer	1,283.84	1,265.69	1,308.00	1,284.00	1,327.84	5	623
Somerset	2,051.35	2,425.00	2,279.41	2,305.88	1,979.49	3	369
Venango	1,153.70	1,200.00	1,165.45	1,140.00	1,009.52	2	607
Washington	1,219.08	1,295.18	1,315.85	1,307.93	1,335.63	4	482
Westmoreland	1,489.72	1,427.82	1,394.89	1,387.23	1,249.17	7	404
ENTIRE STATE	1,541.08	1,563.97	1,555.88	1,559.94	1,466.40	247	499

TABLE 2.2.6.-6

CHARACTERISTICS OF WATER UTILITIES AND SEWER AUTHORITIES

	WATER UTILITIES						SEWER AUTHORITIES			
	Number of Utilities		Metered Customers		Million Gallons Sold		Number of Authorities		Number of Customers	
County	1972	1975	1972	1975	1972	1975	1972	1975	1972	1975
Alle	49	51	405681	416656	62142	56430	29	34	373081	379053
Arms	16	17	5320	5835	1927	1652	4	5	5161	5083
Beav	16	17	44371	46294	7072	8348	12	15	30261	35092
Butl	13	14	16650	19339	2551	2713	8	10	13058	14516
Camb	30	32	41353	42461	45596	44149	9	14	33783	13151
Clar	15	14	5875	6198	615	683	3	5	2652	3671
Clea	18	19	14173	15232	1703	1833	4	4	10340	10675
Elk	7	7	8176	8337	1813	1385	4	5	5494	6777
Faye	15	19	32348	34907	3165	4346	7	9	8795	19421
Fore	3	3	530	485	69	55	--	--	--	--
Gree	7	8	11974	13176	716	777	5	5	2702	847
Indi	16	14	11084	12716	1528	1447	2	2	7686	3354
Jeff	13	10	8688	8926	978	960	3	3	5280	5283
Lawr	8	7	23448	23472	3811	3235	2	4	11882	12110
Merc	11	11	24596	51655	4532	4213	5	8	8162	10421
Some	19	19	11988	12707	1513	1929	4	7	20225	6509
Vena	11	11	7764	11478	1877	1952	6	7	7757	10676
Wash	17	16	50745	52176	6294	6373	7	13	22887	36350
West	17	19	81641	86155	13910	14671	13	20	49375	46526
TOTAL	301	308	806405	868205	161812	157151	127	170	618581	619515
STATE	906	925	2443922	2572746			419	573	1459786	1698153

TABLE 2.2.7-1

AGRICULTURAL CASH RECEIPTS 1974
% OF 1971 RECEIPTS
PENNSYLVANIA ORBES COUNTIES
CROPS

County	Field Crops	%	Vegetables Potatoes	%	Forest and Maple	%	Horticult.	%	Fruits
ALLE	579	159.6	430	-27.6	19	35.7	6223	118.7	539
ARMS	2849	159.7	169	48.2	140	41.4	11814	49.6	85
BEAV	1409	159.5	67	-23.9	29	38.1	565	127.8	26
BUTL	3793	160.0	1391	66.0	107	42.7	8949	-15.7	355
CAMB	1321	159.5	4989	171.4	243	42.1	553	128.5	10
CLAR	1822	159.9	496	112.9	47	42.4	109	127.1	21
CLEA	1046	160.2	302	122.1	230	42.0	524	127.8	45
ELK	186	158.3	19	46.2	16	33.3	0	0.0	0
FAYE	2148	160.0	144	5.1	70	42.9	588	128.8	21
FORE	54	157.1	17	183.3	32	39.1	27	125.0	0
GREE	984	159.6	146	305.6	77	40.0	160	128.6	24
INDI	3419	159.8	1518	79.0	732	42.1	3046	128.3	47
JEFF	1345	159.7	81	65.3	165	41.0	406	128.1	7
LAWR	3569	159.8	140	-42.9	94	42.4	1029	85.7	139
MERC	4472	159.8	475	29.8	102	41.7	2111	128.2	83
SOME	3086	159.8	2109	161.0	468	41.4	893	127.8	7
VENA	739	160.2	197	126.4	75	41.5	571	128.4	37
WASH	3632	159.8	304	-12.4	89	41.3	647	127.8	263
WEST	4359	159.9	227	39.3	52	41.4	1578	72.3	35

TABLE 2.2.7-1
(Con't)

LIVESTOCK

County	%	Meat Animals	%	Dairy Products	%	Poultry Products	%	Govern't Payments	%	Total	%
ALLE	76.7	1051	21.8	1278	33.7	2063	70.5	8	-86.2	12190	72.4
ARMS	1.2	1738	21.7	4861	33.7	940	70.6	194	-35.1	22790	49.9
BEAV	-65.8	831	21.7	3157	33.7	759	70.6	29	-66.3	6872	51.0
BUTL	31.5	2513	21.7	5757	33.7	6286	70.4	144	-53.1	29295	24.0
CAMB	-44.4	2190	21.7	2438	33.7	3411	70.5	91	-44.2	15246	78.0
CLAR	16.7	904	21.7	4208	33.7	1376	70.5	91	-58.1	9074	52.6
CLEA	-49.4	653	21.6	3037	33.7	1109	70.4	76	-36.7	7022	52.7
ELK	0.0	148	-87.9	901	-86.7	427	-83.0	10	-96.2	1707	-84.4
FAYE	0.0	1218	21.7	4721	33.7	1362	70.5	107	-41.8	10379	52.5
FORE	0.0	48	23.1	218	33.7	87	70.6	3	-72.7	486	48.2
GREE	33.3	1623	21.7	2291	33.7	300	70.5	141	-44.7	5746	42.3
INDI	-42.0	2060	21.7	7227	33.7	4961	70.4	105	-66.3	23115	60.3
JEFF	-70.8	873	21.8	4639	33.7	1456	70.5	76	-58.0	9048	48.1
LAWR	10.3	2067	21.7	5571	33.7	1032	70.3	81	-70.4	13722	50.6
MERC	69.4	2913	21.7	9227	33.7	1216	70.3	266	-48.2	20865	52.8
SOME	-68.2	3297	21.7	19134	33.7	1967	70.5	165	-35.5	31126	47.0
VENA	-39.3	507	21.6	2418	33.7	315	71.2	78	-47.3	4937	49.9
WASH	38.4	2801	21.7	10168	33.7	1686	70.5	192	-36.4	19782	46.7
WEST	-22.2	2312	21.6	9794	33.7	3322	70.4	154	-53.8	21833	52.2
										265235	41.7

TABLE 2.2.7.-2

LAND USE, INVENTORIES ACRES X 1,000
1968 and 1974

	Cropland		Pasture		Forest		Other	
County	1968	1974	1968	1974	1968	1974	1968	1974
Alle	32.6	26.8	8.5	7.0	86.3	86.3	83.0	74.8
Arms	101.6	91.9	26.5	27.5	218.9	219.6	44.0	53.3
Beav	58.9	48.0	22.5	18.2	134.6	134.6	16.4	10.6
Butl	135.0	124.6	18.6	18.1	261.6	261.6	51.4	50.1
Camb	76.9	69.8	7.4	7.0	284.6	284.6	39.8	32.9
Clar	63.9	62.6	15.0	14.8	272.6	270.8	6.7	6.6
Clea	47.9	43.0	12.7	11.0	608.0	608.0	25.2	25.4
Elk	18.6	17.3	1.1	1.0	360.4	360.4	7.3	8.2
Faye	85.9	84.8	25.5	23.9	317.3	320.8	35.0	34.3
Fore	4.8	4.8	2.0	2.0	138.1	138.6	3.0	3.1
Gree	53.5	32.8	137.0	56.5	147.8	148.0	10.0	108.9
Indi	133.2	131.8	27.3	27.2	289.4	286.3	32.3	32.0
Jeff	62.5	57.7	11.7	10.4	292.8	292.8	21.9	24.0
Lawr	68.4	68.7	24.4	23.8	92.7	92.7	28.2	27.8
Merc	141.9	128.4	43.6	38.8	147.6	136.0	47.1	43.8
Some	127.4	127.7	42.4	42.0	443.4	443.4	41.9	42.3
Vena	37.6	37.1	9.9	9.5	352.7	353.2	12.0	19.5
Wash	135.0	129.9	130.0	127.9	192.7	192.0	38.5	40.0
West	154.8	114.3	55.2	37.4	312.1	312.1	54.5	100.2
ORBES TOTAL	1,535.4	1,402.0	621.1	504.0	4,953.6	4,941.8	598.2	737.8

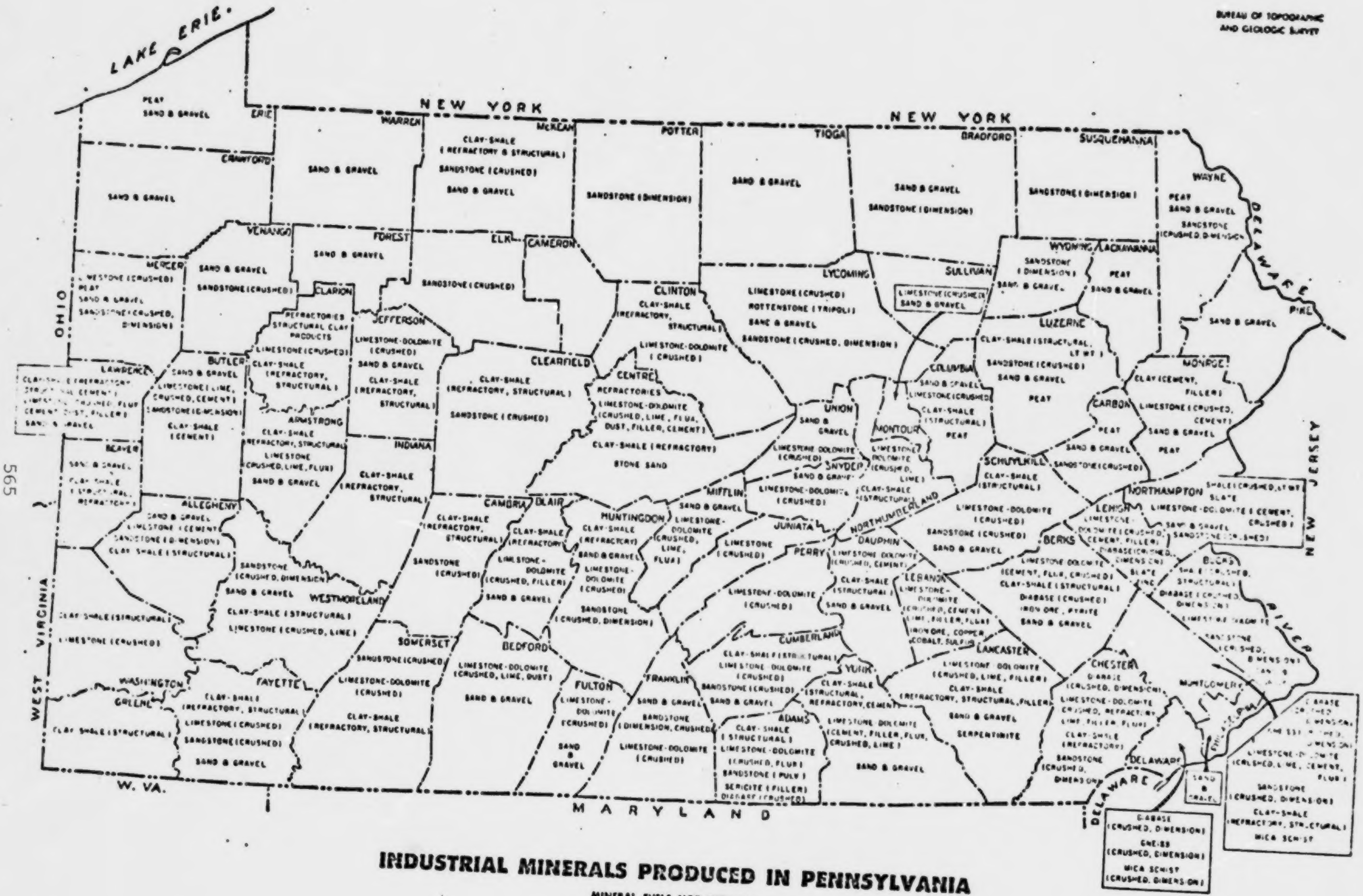
TABLE 2.2.7.-3

CRUDE PETROLEUM SHIPMENTS
AS % OF 1970 SHIPMENTS

County	Barrels* 1970	1971	1972	1973	1974	1975
Alle	70,113	106.0	97.1	91.7	88.3	83.9
Arms	8,696	105.9	101.1	112.3	136.4	141.0
Beav	7,202	92.4	78.4	62.8	63.5	60.3
Butl	105,600	90.3	81.2	73.9	74.6	73.5
Camb	---	---	---	---	---	---
Clar	18,980	103.4	111.3	120.9	126.9	122.6
Clea	---	---	---	---	---	---
Elk	31,791	95.6	80.7	57.1	115.0	76.2
Faye	227	84.6	48.9	82.4	70.0	61.2
Fore	39,905	188.8	244.6	253.4	315.5	345.0
Gree	36,524	100.5	89.8	90.2	86.5	88.3
Indi	---	---	---	---	---	---
Jeff	1,486	117.3	92.2	115.3	161.0	182.6
Lawr	---	---	---	---	---	---
Merc	886	88.0	109.5	394.7	1,799.4	621.4
Some	---	---	---	---	---	---
Vena	311,121	279.9	177.2	156.5	161.9	176.5
Wash	110,421	109.9	101.5	99.5	95.1	90.1
West	---	---	---	---	---	---
ORBES TOTAL	742,952					
STATE TOTAL	3,690,435	102.9	93.2	81.3	88.5	84.2

*42 gallon barrels

BUREAU OF TOPOGRAPHIC
AND GEOLOGIC SURVEY

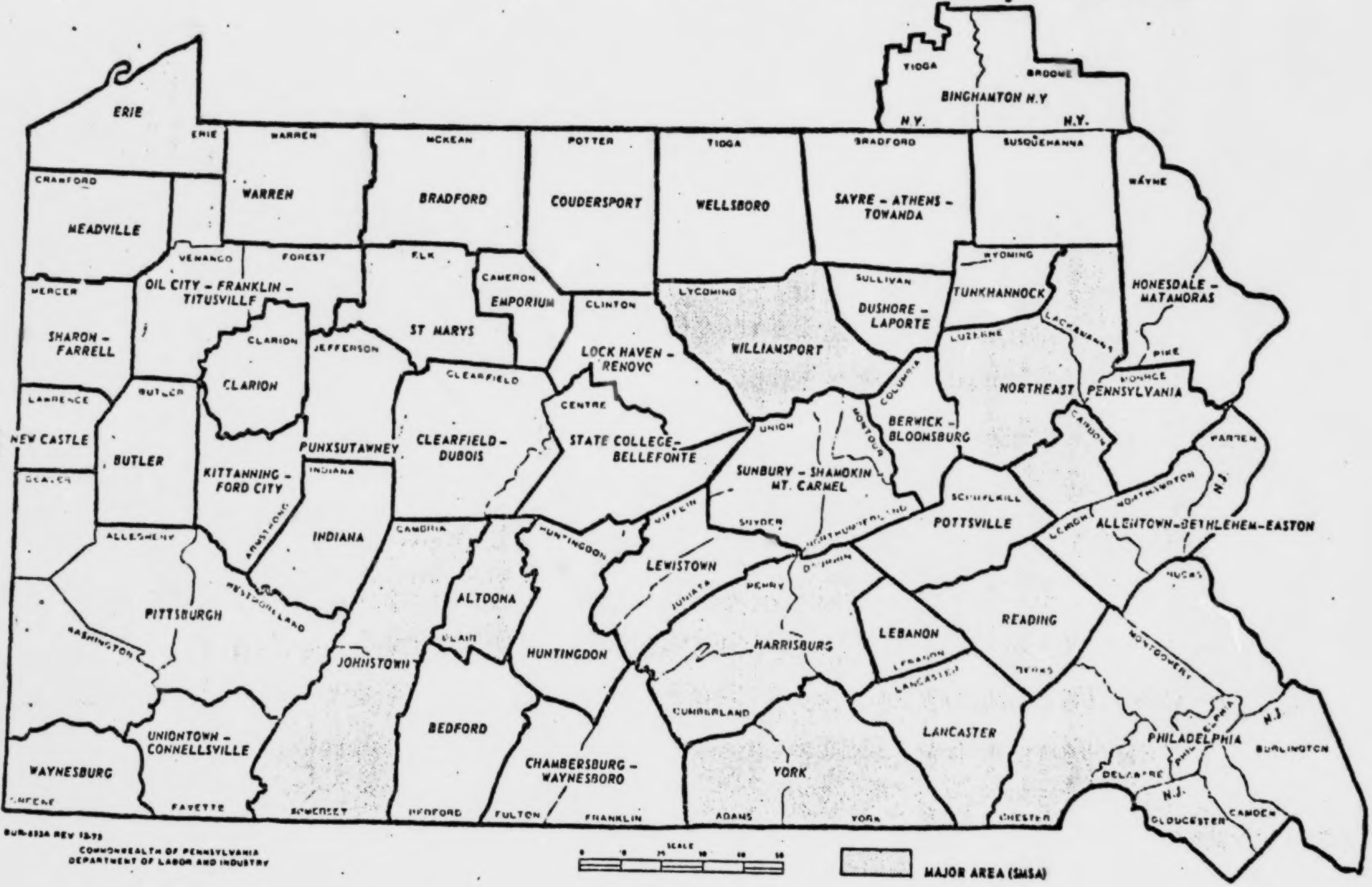

LAKE ERIE
NEW YORK
NEW YORK
OHIO
WEST VIRGINIA
W. VA.
MARYLAND
DELAWARE
NEW JERSEY
DELAWARE RIVER
ERIE
PEAT
SAND & GRAVEL
CRAWFORD
SAND & GRAVEL
WARREN
SAND & GRAVEL
McKEAN
CLAY-SHALE (REFRACTORY & STRUCTURAL)
SANDSTONE (CRUSHED)
SAND & GRAVEL
POTTER
SANDSTONE (DIMENSION)
TIOGA
SAND & GRAVEL
BRADFORD
SAND & GRAVEL
SANDSTONE (DIMENSION)
SUSQUEHANNA
SANDSTONE (DIMENSION)
WAYNE
PEAT
SAND & GRAVEL
SANDSTONE (CRUSHED, DIMENSION)
PIKE
SAND & GRAVEL
MERCER
LIMESTONE (CRUSHED)
PEAT
SAND & GRAVEL
SANDSTONE (CRUSHED, DIMENSION)
VENANGO
SAND & GRAVEL
SANDSTONE (CRUSHED)
FOREST
SAND & GRAVEL
ELK
SANDSTONE (CRUSHED)
CAMERON
CLINTON
CLAY-SHALE (REFRACTORY, STRUCTURAL)
LIMESTONE-DOLOMITE (CRUSHED)
LYCOMING
LIMESTONE (CRUSHED)
ROTTENSTONE (TRIPOLI)
SAND & GRAVEL
SANDSTONE (CRUSHED, DIMENSION)
SULLIVAN
LIMESTONE (CRUSHED)
SAND & GRAVEL
WYOMING
SANDSTONE (DIMENSION)
SAND & GRAVEL
LACKAWANNA
PEAT
SAND & GRAVEL
LAWRENCE
CLAY-SHALE (REFRACTORY, STRUCTURAL, CEMENT)
LIMESTONE (CRUSHED, FLUX, CEMENT, DUST, FILLER)
SAND & GRAVEL
CLARION
REFRACTORIES
STRUCTURAL CLAY PRODUCTS
LIMESTONE (CRUSHED)
CLAY-SHALE (REFRACTORY, STRUCTURAL)
JEFFERSON
LIMESTONE-DOLOMITE (CRUSHED)
SAND & GRAVEL
CLAY-SHALE (REFRACTORY, STRUCTURAL)
CLEARFIELD
CLAY-SHALE (REFRACTORY, STRUCTURAL)
SANDSTONE (CRUSHED)
CENTRE
REFRACTORIES
LIMESTONE-DOLOMITE (CRUSHED, LIME, FLUX, DUST, FILLER, CEMENT)
CLAY-SHALE (REFRACTORY)
STONE SAND
UNION
SAND & GRAVEL
COLUMBIA
SAND & GRAVEL
LIMESTONE (CRUSHED)
CLAY-SHALE (STRUCTURAL)
PEAT
LUZERNE
CLAY-SHALE (STRUCTURAL, LT WT)
SANDSTONE (CRUSHED)
SAND & GRAVEL
PEAT
MONROE
CLAY (CEMENT, FILLER)
LIMESTONE (CRUSHED, CEMENT)
SAND & GRAVEL
PEAT
BUTLER
SAND & GRAVEL
LIMESTONE (LIME, CRUSHED, CEMENT)
SANDSTONE (DIMENSION)
CLAY-SHALE (CEMENT)
ARMSTRONG
CLAY-SHALE (REFRACTORY, STRUCTURAL)
LIMESTONE (CRUSHED, LIME, FLUX)
SAND & GRAVEL
INDIANA
CLAY-SHALE (REFRACTORY, STRUCTURAL)
BEAVER
SAND & GRAVEL
CLAY-SHALE (STRUCTURAL, REFRACTORY)
ALLEGHENY
SAND & GRAVEL
LIMESTONE (CEMENT)
SANDSTONE (DIMENSION)
CLAY-SHALE (STRUCTURAL)
MONTOUR
LIMESTONE-DOLOMITE (CRUSHED, LIME)
SNYDER
LIMESTONE-DOLOMITE (CRUSHED)
SAND & GRAVEL
CARBON
PEAT
SAND & GRAVEL
SANDSTONE (CRUSHED)
SCHUYLKILL
CLAY-SHALE (STRUCTURAL)
NORTHUMBERLAND
CLAY-SHALE (STRUCTURAL)
LIMESTONE-DOLOMITE (CRUSHED)
SANDSTONE (CRUSHED)
SAND & GRAVEL
NORTHAMPTON
SHALE (CRUSHED, LT WT)
SLATE
LIMESTONE-DOLOMITE (CEMENT, CRUSHED)
SAND & GRAVEL
SANDSTONE (CRUSHED)
CAMBRIA
CLAY-SHALE (REFRACTORY, STRUCTURAL)
SANDSTONE (CRUSHED)
BLAIR
CLAY-SHALE (REFRACTORY)
LIMESTONE-DOLOMITE (CRUSHED, FILLER)
SAND & GRAVEL
HUNTINGDON
CLAY-SHALE (REFRACTORY)
SAND & GRAVEL
LIMESTONE-DOLOMITE (CRUSHED)
SANDSTONE (CRUSHED, DIMENSION)
MIFFLIN
SAND & GRAVEL
LIMESTONE-DOLOMITE (CRUSHED, LIME, FLUX)
JUNIATA
LIMESTONE (CRUSHED)
PERRY
LIMESTONE-DOLOMITE (CRUSHED)
DAUPHIN
LIMESTONE-DOLOMITE (CRUSHED, CEMENT)
CLAY-SHALE (STRUCTURAL)
SAND & GRAVEL
LEBANON
LIMESTONE-DOLOMITE (CRUSHED, CEMENT, LIME, FILLER, FLUX)
IRON ORE, COPPER, COBALT, SULFUR
LEHIGH
LIMESTONE-DOLOMITE (CRUSHED, CEMENT, FILLER)
SLATE
ZINC
BERKS
LIMESTONE-DOLOMITE (CEMENT, FLUX, CRUSHED)
CLAY-SHALE (STRUCTURAL)
DIABASE (CRUSHED)
IRON ORE, PYRITE
SAND & GRAVEL
BUCKS
SHALE (CRUSHED, STRUCTURAL)
DIABASE (CRUSHED, DIMENSION)
LIMESTONE-DOLOMITE
SANDSTONE (CRUSHED, DIMENSION)
SAND & GRAVEL
WASHINGTON
CLAY-SHALE (STRUCTURAL)
LIMESTONE (CRUSHED)
GREENE
CLAY-SHALE (STRUCTURAL)
WESTMORELAND
SANDSTONE (CRUSHED, DIMENSION)
SAND & GRAVEL
CLAY-SHALE (STRUCTURAL)
LIMESTONE (CRUSHED, LIME)
FAYETTE
CLAY-SHALE (REFRACTORY, STRUCTURAL)
LIMESTONE (CRUSHED)
SANDSTONE (CRUSHED)
SAND & GRAVEL
SOMERSET
SANDSTONE (CRUSHED)
LIMESTONE-DOLOMITE (CRUSHED)
CLAY-SHALE (REFRACTORY, STRUCTURAL)
BEDFORD
LIMESTONE-DOLOMITE (CRUSHED, LIME, DUST)
SAND & GRAVEL
FULTON
LIMESTONE-DOLOMITE (CRUSHED)
SAND & GRAVEL
FRANKLIN
SAND & GRAVEL
SANDSTONE (DIMENSION, CRUSHED)
LIMESTONE-DOLOMITE (CRUSHED)
CUMBERLAND
CLAY-SHALE (STRUCTURAL)
LIMESTONE-DOLOMITE (CRUSHED)
SANDSTONE (CRUSHED)
SAND & GRAVEL
ADAMS
CLAY-SHALE (STRUCTURAL)
LIMESTONE-DOLOMITE (CRUSHED, FLUX)
SANDSTONE (PULV)
SERICITE (FILLER)
DIABASE (CRUSHED)
YORK
CLAY-SHALE (STRUCTURAL, REFRACTORY, CEMENT)
LIMESTONE-DOLOMITE (CEMENT, FILLER, FLUX, CRUSHED, LIME)
SAND & GRAVEL
LANCASTER
LIMESTONE-DOLOMITE (CRUSHED, LIME, FILLER)
CLAY-SHALE (REFRACTORY, STRUCTURAL, FILLER)
SAND & GRAVEL
SERPENTINITE
CHESTER
DIABASE (CRUSHED, DIMENSION)
LIMESTONE-DOLOMITE (CRUSHED, REFRACTORY, LIME, FILLER, FLUX)
CLAY-SHALE (REFRACTORY)
SANDSTONE (CRUSHED, DIMENSION)
MONTGOMERY
DIABASE (CRUSHED, DIMENSION)
GNEISS (CRUSHED, DIMENSION)
LIMESTONE-DOLOMITE (CRUSHED, LIME, CEMENT, FLUX)
SANDSTONE (CRUSHED, DIMENSION)
CLAY-SHALE (REFRACTORY, STRUCTURAL)
MICA SCHIST
PHILADELPHIA
SAND & GRAVEL
DELAWARE
DIABASE (CRUSHED, DIMENSION)
GNEISS (CRUSHED, DIMENSION)
MICA SCHIST (CRUSHED, DIMENSION)

INDUSTRIAL MINERALS PRODUCED IN PENNSYLVANIA

MINERAL FUELS NOT INCLUDED

FIGURE 2.2.7-1

Labor Market Areas of Pennsylvania

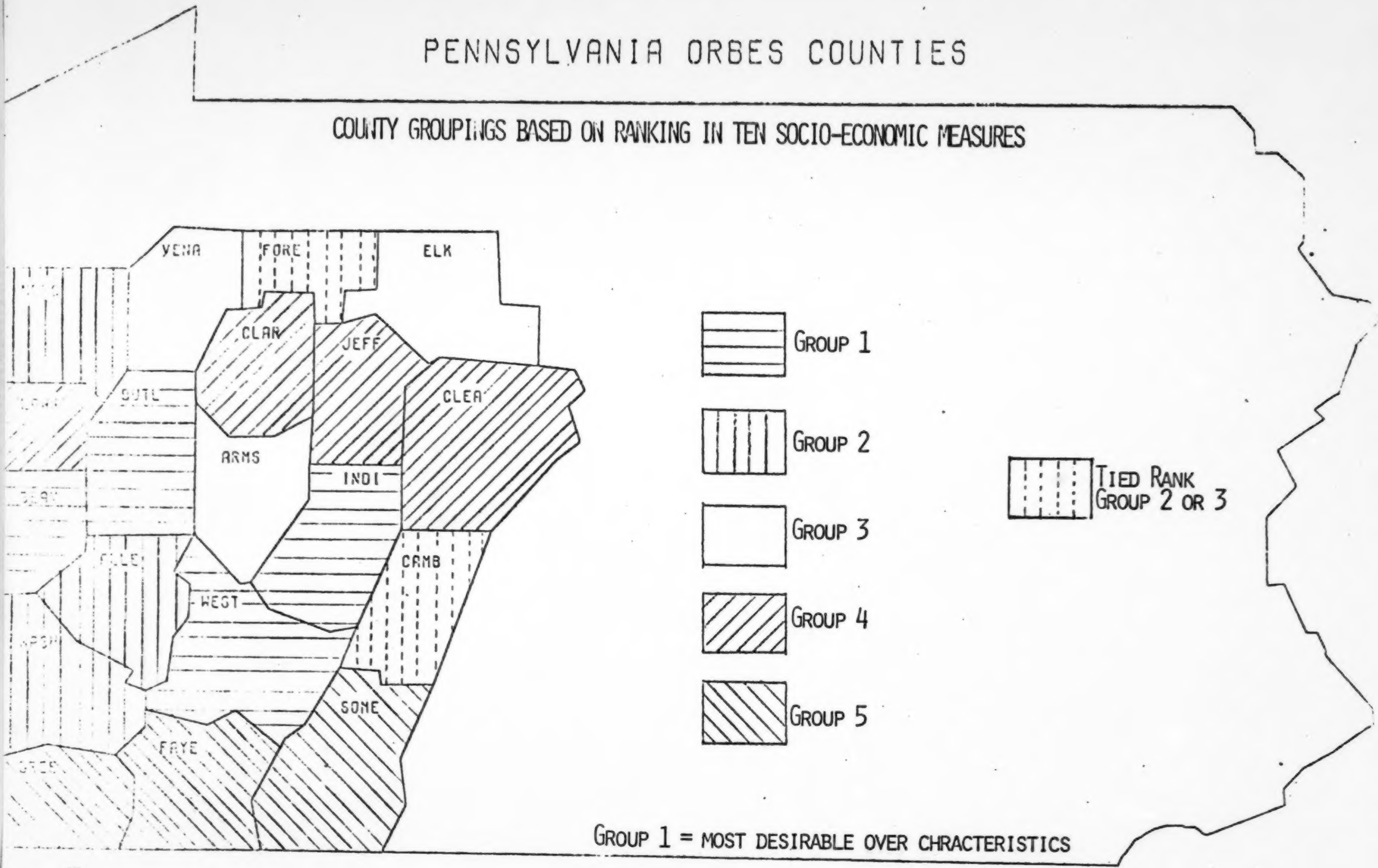

ERIE
ERIE
CRAWFORD
MEADVILLE
WARREN
WARREN
MCKEAN
BRADFORD
POTTER
COUDERSPORT
TIOGA
WELLSBORO
BRADFORD
SAYRE - ATHENS - TOWANDA
TIOGA
BROOME
BINGHAMTON N.Y.
N.Y.
N.Y.
SUSQUEHANNA
WAYNE
HONESDALE - MATAMORAS
PIKE
VENANGO
FOREST
MERCER
OIL CITY - FRANKLIN - TITUSVILLE
SHARON - FARRELL
CLARION
CLARION
ELK
ST MARYS
CAMERON
EMPORIUM
CLINTON
LOCK HAVEN - RENOVO
LYCOMING
WILLIAMSPORT
SULLIVAN
DUSHORE - LAPORTE
WYOMING
TUNKHANNOCK
LUZERNE
LACKAWANNA
NORTHEAST PENNSYLVANIA
MONROE
LAWRENCE
NEW CASTLE
BUTLER
BUTLER
JEFFERSON
PUNXSUTAWNEY
CLEARFIELD
CLEARFIELD - DUBOIS
CENTRE
STATE COLLEGE - BELLEFONTE
UNION
MONTOUR
COLUMBIA
BERWICK - BLOOMSBURG
CARBON
SUNBURY - SHAMOKIN MT. CARMEL
BEAVER
KITTANNING - FORD CITY
ARMSTRONG
INDIANA
INDIANA
CAMBRIA
MIFFLIN
SNYDER
NORTHUMBERLAND
SCHUYLKILL
POTTSVILLE
WARREN
NORTHAMPTON
N.J.
LEHIGH
ALLENTOWN-BETHLEHEM-EASTON
ALLEGHENY
WESTMORELAND
PITTSBURGH
WASHINGTON
HUNTINGDON
LEWISTOWN
JUNIATA
PERRY
DAUPHIN
ALTOONA
BLAIR
JOHNSTOWN
HUNTINGDON
HARRISBURG
LEBANON
LEBANON
READING
BERKS
BUCKS
MONTGOMERY
CUMBERLAND
LANCASTER
LANCASTER
PHILADELPHIA
PHILA.
N.J.
BURLINGTON
DELAWARE
N.J.
GLOUCESTER
CAMDEN
UNIONTOWN - CONNELLSVILLE
BEDFORD
CHAMBERSBURG - WAYNESBORO
YORK
WAYNESBURG
GREENE
FAYETTE
SOMERSET
BEDFORD
FULTON
FRANKLIN
ADAMS
YORK
CHESTER
BUR-6334 REV 12-75
SCALE
0
10
20
30
40
50
MAJOR AREA (SMSA)

COMMONWEALTH OF PENNSYLVANIA
DEPARTMENT OF LABOR AND INDUSTRY

FIGURE 2.2.8-1

PENNSYLVANIA ORBES COUNTIES

COUNTY GROUPINGS BASED ON RANKING IN TEN SOCIO-ECONOMIC MEASURES


VENA
FORE
ELK
CLAR
JEFF
CLEA
BUTL
ARMS
INDI
CAMB
WEST
SOME
FAYE
GROUP 1
GROUP 2
GROUP 3
GROUP 4
GROUP 5
TIED RANK
GROUP 2 OR 3

GROUP 1 = MOST DESIRABLE OVER CHRACTERISTICS

FIGURE 2.2.-8-2

TABLE 2.2.8-1

PENNSYLVANIA ORBES COUNTIES

AGED DEPENDENCY RATIO AS PERCENT OF TOTAL DEPENDENCY RATIO, 1970

RANGE OF VALUES 23.1% TO 36.6%

Percent	Counties
less than 25.1	Elk (23.1), Butler (24.5)
25.1 to 27.0	Beaver (25.1), Westmoreland (26.3)
27.1 to 29.0	Mercer (27.7), Indiana (28.2), Venango (28.5), Cambria (28.7)
29.1 to 31.0	Lawrence (29.1), Washington (29.1), Allegheny (29.6), Clarion (29.6) Clearfield (30.1), Armstrong (30.4), Somerset (31.0)
greater than 31.0	Fayette (31.3), Greene (34.0), Jefferson (34.3), Forest (36.6)

TABLE 2.2.8-2

PENNSYLVANIA ORBES COUNTIES

POPULATION DENSITY, PERSONS PER SQUARE MILE
1970

RANGE OF VALUES 11.8 to 2204.7

Density	Counties
less than 100	Forest (11.8), Elk (46.8), Greene (62.4), Clarion (64.3) Clearfield (65.5), Jefferson (67.0), Somerset (70.5), Venango (92.0), Indiana (96.3)
101 to 200	Armstrong (115.9), Butler (161.0), Mercer (189.8), Fayette (192.9)
201 to 500	Washington (246.1), Cambria (269.9), Lawrence (292.6), Westmoreland (368.1), Beaver (473.7)
greater than 500	Allegheny (2204.7)

TABLE 2.2.8-3

PENNSYLVANIA ORBES COUNTIES

MEDIAN FAMILY INCOME, 1970

RANGE OF VALUES $7170 to $10090

Median Income, $	Counties
less than 7,500	Fayette (7170), Greene (7337), Clearfield (7488)
7,501 to 8,000	Jefferson (7520), Somerset (7634), Clarion (7635), Armstrong (7702) Indiana (7947)
8,001 to 8,500	Venango (8248), Forest (8291), Elk (8472)
8,501 to 9,000	Cambria (8563), Lawrence (8664), Washington (8664)
9,001 to 9,500	Butler (9032), Mercer (9287), Westmoreland (9293), Beaver (9428)
greater than 9,501	Allegheny (10090)

TABLE 2.2.8-4

PENNSYLVANIA ORBES COUNTIES

PERCENT CHANGE IN THE LABOR FORCE 1960-1970

RANGE OF VALUES -10.3% to 14.7%

Percent	Counties
decreased more than -5.0	Green (-10.3), Fayette (-7.2), Cambria (-6.1)
-4.9 to -1.6	Venango(-4.6), Clearfield (-4.5), Jefferson (-3.4), Lawrence (-2.9)
-1.5 to +1.5	Armstrong (-1.1), Washington (-0.5), Allegheny (-0.15), Mercer (+0.9)
1.6 to 4.9	Clarion (1.6), Beaver (2.0), Elk (4.3)
5.0 to 9.9	Somerset (5.0), Forest (7.1)
more than 10.0	Indiana (10.2), Westmoreland (11.2), Butler (14.7)

TABLE 2.2.8-5

PENNSYLVANIA ORBES COUNTIES

PERCENT CHANGE IN MANUFACTURING EMPLOYMENT 1972-1975

RANGE OF VALUES -14.2 to 15.9

Percent	Counties
decreased more than -10.0	Elk (-14.2), Somerset (-13.2), Clarion (-10.8)
-9.9 to -4.0	Fayette (-6.4), Lawrence (-5.7), Forest (-4.3) Mercer (-4.1)
-3.9 to 0.0	Westmoreland (-3.4), Allegheny (-1.2),Jefferson (-0.9)
0.1 to 4.0	Cambria (0.3), Indiana (1.7), Washington (2.9)
4.1 to 10.0	Beaver (6.1)
more than 10.0	Venango (10.1), Armstrong (11-6), Butler (14.2) Clearfield (14.8), Greene (15.9)

TABLE 2.2.8-6

PENNSYLVANIA ORBES COUNTIES

PERCENT OF HOUSING CONSTRUCTAL 1960-1970

RANGE OF VALUES; 8.2% to 28.1%

Percent	Counties
less than 10.0	Cambria (8.2), Greene (8.7), Jefferson (9.0), Clearfield (9.4) Fayette (9.8)
10.1 to 14.0	Venango (11.6), Lawrence (11.9), Armstrong (12.1) Somerset (13.0), Elk (13.4), Allegheny (13.6), Beaver (13.8)
14.1 to 18.0	Mercer (14.9), Washington (15.1), Indiana (16.0), Clarion (16.7)
18.1 to 22.0	Westmoreland (19.2), Butler (21.2)
more than 22.0	Forest (28.1)

TABLE 2.2.8-7

PENNSYLVANIA ORBES COUNTIES

PERCENT CHANGE IN TAXABLE REAL PROPERTY MARKET VALUE 1970-1975

RANGE OF VALUES; 20.4% to 45.9%

Percent	Counties
less than 25.0	Mercer (20.4), Greene (21.0), Allegheny (21.4)
25.1 to 30.0	Beaver (26.9), Elk (28.9), Lawrence (29.3), Armstrong (29.4)
30.1 to 35.0	Somerset (31.0), Cambria (32.2), Westmoreland (32.7) Venango (33.1), Washington (34.3)
35.1 to 39.0	NONE
more than 39.0	Fayette (39.8), Butler (41.8), Indiana (42.5), Clearfield (43.5) Clarion (45.5), Jefferson (45.7), Forest (45.9)

TABLE 2.2.8-8

PENNSYLVANIA ORBES COUNTIES
PERCENT OF POPULATION RECEIVING PUBLIC ASSISTANCE
1976

RANGE OF VALUES; 2.8% to 9.4%

Percent	Counties
less than 3.5	Elk (2.8), Butler (3.4), Cambria (3.4)
3.5 to 4.0	Indiana (3.5), Jefferson(3.6), Clarion (3.7), Beaver (3.8) Westmoreland (3.8), Clearfield (3.9), Forest (4.0)
4.1 to 4.5	Somerset (4.2)
4.6 to 5.0	Armstrong (4.6), Venango (4.8), Washington (4.8), Mercer (5.0)
greater than 5.0	Lawrence (5.4), Allegheny (6.9), Greene (9.4), Fayette (9.8)

TABLE 2.2.8-9

PENNSYLVANIA ORBES COUNTIES

1975 PER PUPIL EDUCATION EXPENDITURE

RANGE OF VALUES; $1152 to $1514

Expenditure $	Counties
less than 1200	Clearfield (1152) Somerset (1178)
1201 to 1250	Clarion (1205), Elk (1211), Westmoreland (1216), Butler (1220) Washington (1221), Lawrence (1227), Indiana (1246)
1251 to 1300	Forest (1254) Fayette (1256), Greene (1256), Venango (1260), Jefferson (1261), Beaver (1274)
more than 1300	Cambria (1333), Armstrong (1363), Mercer (1363), Allegheny (1514)

TABLE 2.2.8-10

PENNSYLVANIA ORBES COUNTIES

PERCENT OF STATE CONTRIBUTION TO 1975 PER PUPIL EDUCATION EXPENDITURE

RANGE OF VALUES 37.2% to 71.7%

Percent	Counties
less than 50	Allegheny (37.2), Beaver (49.4), Mercer (49.4)
50 to 59	Westmoreland (54.4), Washington (55.0), Butler (56.2) Lawrence (57.1), Forest (57.7), Elk (58.1)
60 to 69	Greene (60.0), Indiana (60.0), Cambria (60.3), Armstrong (62.0) Venango (62.2), Jefferson (68.4), Somerset (68.8)
more than 69	Clearfied (69.3), Clarion (70.2), Fayette (71.7)

TABLE 2.2.8-11
PENNSYLVANIA ORBES COUNTIES
RANKING OF COUNTY VALUES FOR TEN CHARACTERISTICS

County	1	2	3	4	5	6	7	8	9	10	Σ	Rank
ALLE	11	1	1	10	11	9	17	17	1	1	79	5
ARMS	14	10	13	12	4	12	13	12	3	13	106	11
BEAV	3	2	2	7	6	8	16	7	5	2	58	2
BUTL	2	9	5	1	3	2	6	2	14	6	50	1
CAMB	8	5	8	17	9	19	11	3	4	12	96	8.5
CLARI	12	16	14	8	17	4	3	6	17	18	115	14
CLEAR	13	15	17	15	2	16	4	9	19	17	127	16
ELK	1	18	9	6	19	10	15	1	16	9	104	10
FAYETTE	16	7	19	18	16	15	7	19	9	19	145	19
FOREST	19	19	10	4	14	1	1	10	10	8	96	8.5
GREENE	17	17	18	19	1	18	18	18	8	10	144	18
INDIANA	6	11	12	3	8	5	5	4	11	11	76	4
JEFFERSON	18	14	16	14	10	17	2	5	6	15	117	15
LAWRENCE	9	4	7	13	15	13	14	16	12	7	110	13
MERCER	5	8	4	9	13	7	19	15	2	3	85	6
SOMERSET	15	13	15	5	18	11	12	11	18	16	134	17
VENANGO	7	12	11	16	5	14	9	13	7	14	108	12
WASH	10	6	6	11	7	6	8	14	13	5	86	7
WEST	4	3	3	2	12	3	10	8	15	4	64	3

TYPING GUIDE SHEET

APPENDIX A

KEY TO ALPHA - NUMERIC DESCRIPTORS
OF NATURAL AREAS
IN THE PENNSYLVANIA ORBES REGION

EPA-287 (Cin.)
(4-76)

APPENDIX A

KEY TO ALPHA - NUMERIC DESCRIPTORS
OF NATURAL AREAS
IN THE PENNSYLVANIA ORBES REGION

FORMAT: Name of Site - County; 7.5' USGS Quad.; distance and direction from the nearest city; size in acres; owner; protection status.

Key type Other types K types
See Table 2.1.4.-1

SAF = Forest types

OVT = Herbs, Scenic & Research types

Z = Zoologic types

G = Geologic types

A = Aquatic types

FOREST TYPES

SAF 16 Aspen

SAF 18 Paper Birch

SAF 19 Gray Birch - Red Maple

SAF 21 White Pine

SAF 22 White Pine - Hemlock

SAF 23 Hemlock

SAF 24 Hemlock - Yellow Birch

SAF 25 Sugar Maple - Beech - Yellow Birch

SAF 26 Sugar Maple - Basswood

SAF 27 Sugar Maple

SAF 28 Black Cherry - Sugar Maple

SAF 29 Black Cherry

SAF 39 Black Ash - American Elm - Red Maple

SAF 41 Scarlet Oak

SAF 43 Bear Oak

SAF 44 Chestnut Oak

SAF 45 Pitch Pine

SAF 46 Eastern Red Cedar

SAF 50 Black Locust

SAF 51 White Pine - Chestnut Oak

SAF 52 White Oak - Red Oak - Hickory

SAF 53 White Oak

SAF 54 Northern Red Oak - Basswood - White Ash

SAF 58 Yellow Poplar - Hemlock

SAF 59 Yellow Poplar - White Oak - Northern Red Oak

SAF 60 Beech - Sugar Maple

SAF 61 River Birch - Sycamore

SAF 63 Cottonwood

HERB, RESEARCH, AND SCENIC TYPES

OVT 3 Sand Barren

OVT 4 Prevernal Herbaceous Flora

OVT 5 Vernal Herbaceous Flora

OVT 6 Meadowlands

OVT 7 Scenic Areas/Natural Vistas

OVT 8 School Study Site/Research Site/ Nature Trail

OVT 9 Rare and Endangered Species Locality

OVT 10 Type locality

OVT 11 Talus Community

OVT 12 Cliff Community

OVT 13 Bryophytes and Ferns

OVT 15 Serotinal Herbaceous Flora

OVT 17 Heath Barren

OVT 19 Thickets

ZOOLOGIC TYPES

Z 9 Arthropoda

Z 13 True Fish

Z 15 Reptiles

Z 16 Birds

Z 17 Mammals

GEOLOGIC TYPES

G 1 Plains, Plateaus, and Mesas

G 6 Folded Mountains

G 9 Caves

G 10 Works of Erosion

G 11 Works of Glaciers

G 13 Volcanoes and Assorted Works

G 16 Igneous (granite, felsite, basalt)

G 17 Sedimentary (clay, sandstone, limestone)

G 23 Carbonates (calcite, aragonite)

G 28 Silicates (quartz, opal, talc, mica)

G 30 Non-human Zoologic

G 31 Botanic

AQUATIC TYPES

A 12 Rapidly Flowing Rivers and Streams

A 13 Slow Meandering Rivers and Streams

A 15 Springs

A 19 Large Shallow Lakes

A 22 Kettle Lakes and Potholes

A 23 Oxbow Lakes

A 25 Sphagnum Bog

A 29 Swamps and Marshy Areas

A 34 Lake Shorelines

TYPING GUIDE SHEET
BEGIN FIRST LINE OF TEXT HERE
CENTER OF PAGE
TOP OF IMAGE AREA
DROPPED HEAD; BEGIN SECTIONS HERE

APPENDIX B

INVENTORY OF
WESTERN PENNSYLVANIA CONSERVANCY
NATURAL AREAS IN THE PENNSYLVANIA
ORBES REGION

6-1/2"
9-1/8"
BEGIN LAST LINE OF TEXT
BOTTOM OF IMAGE AREA; OUTSIDE DIMENSION FOR TABLES AND ILLUSTRATIONS
3/8"
PAGE NUMBER
EPA-287 (Cin.)
(4-76)

APPENDIX B

INVENTORY OF
WESTERN PENNSYLVANIA CONSERVANCY
NATURAL AREAS IN THE PENNSYLVANIA
ORBES REGION

ALLEGHENY COUNTY

1. A.W. ROBERTSON ARBORETUM-Allegheny; Bridgeville; Pleasant Hills; 16 Ac; A.W. Robertson Corporation; complete protection.
   SAF52 (K104)

2. BOYCE PARK-Allegheny; Braddock; 2 miles N of Monroeville; 50 Ac; Allegheny County Parks; partial protection.
   SAF60 OVT9 (K102)

3. BURKE GLENN FOSSIL SITE-Allegheny; Murrysville; 2 miles W of Murrysville; PennDot; partial protection.
   G30 G17, G1

4. CROUSE RUN-Allegheny; Glenshaw; N of Allison Park; 55 Ac: private; no protection.
   SAF23 SAF61, OVT4, OVT9, OVT7 (K106)

5. DARK HOLLOW WOODS-Allegheny; New Kensington West; just N of Oakmont; 80 Ac; Oakmont Borough; complete protection.
   SAF52 G10 (K104)

6. DEER CREEK-Allegheny; New Kensington West; 2 miles E of Dorseyville; 70 Ac; private; no protection.
   SAF52 SAF23, SAF61, G10 (K104)

7. FALL RUN PARK-Allegheny; Glenshaw; 4 miles N of Etna; 109 Ac; Shaler Township; partial protection.
   OVT10 G10, OVT4, OVT7, SAF59 (K103)

8. 14 MILE ISLAND-Allegheny; New Kensington West; at Harmarville; 60 Ac; Western Pennsylvania Conservancy; complete protection.
   SAF61 SAF62, SAF63, G10, OVT8

9. HARMARVILLE ROAD CUT-Allegheny; New Kensington West; Harmarville; PennDot; no protection.
   G17 G30, G31

10. LAWRENCE ESTATE-Allegheny; Glenshaw; N of Etna; 200 Ac; Allegheny County Parks; partial protection.
    SAF52 (K104)

11. McCORMICK OAKS-Allegheny; Glenshaw; just NE of North Park Dam; 100 Ac; private; no protection.
    SAF52 (K104)

12. PENN HILLS PARK-Allegheny; New Kensington West; just N of Oakmont; 100 Ac; municipal park; no protection.
SAF27 G10, G1, OVT7 (K102)

13. RED CEDAR STAND-Allegheny; Glenshaw; S of Dorseyville; 10 Ac; private; no protection.
SAF46

14. TRILLIUM TRAIL-Allegheny; Glenshaw; NE of Sharpsburg; 100 Ac; Fox Chapel Borough; complete protection.
OVT4 SAF52, SAF59, A12 (K103, K104)

15. TURTLE CREEK-Allegheny & Westmoreland; Murrysville; N of Pitcairn; 300 Ac; private; no protection.
SAF61 G10

16. WHITE OAK PARK-Allegheny; McKeesport; just NE of White Oak; 50 Ac; Allegheny County Parks; partial protection.
SAF60 OVT4 (K102)

ARMSTRONG COUNTY

17. BRADY'S BEND OVERLOOK-Armstrong; East Brady; 2 miles N of East Brady; 2 Ac; PennDot; partial protection.
G10 OVT7

18. BUFFALO CREEK VALLEY-Armstrong & Butler; Freeport and Worthington; between Freeport and Worthington; private; no protection.
A12 SAF52, SAF23, SAF24, Z13, OVT7, OVT4, G10 (K104, K106)

19. CROOKED CREEK STATE PARK-Armstrong; Leechburg & Whitesburg; 2,480 Ac; State Park; partial protection.
SAF52 SAF59, G1 (K103, K104)

20. NICHOLSON ISLAND-Armstrong; Leechburg; just N of lock #6; 40 Ac; Western Pennsylvania Conservancy; complete protection.
SAF62 G10, A29

21. WORTHINGTON FOSSIL SITE-Armstrong; Worthington; 2.7 miles NW of Worthington; private; no protection.
G30 G17

BEAVER COUNTY

22. ALIQUIPPA FOSSIL SITE-Beaver; Aliquippa; 3 miles S of Aliquippa; private; no protection.
G30 G17, G1

23. BLAZING STAR MEADOW-Beaver; Beaver Falls; 1 mile NE of Beaver Falls; 7 Ac; private; no protection.
OVT9 OVT6, OVT15

24. LITTLE BEAVER RIVER-Beaver; East Palestine; N of Ohioville; private; no protection.
G11 OVT7

25. RACCOON CREEK STATE PARK-Beaver; Hookstown & Aliquippa & Burgettstown; 6,909 Ac; State Park: partial protection.
SAF52 SAF59, SAF16, SAF50, G1, A12 OVT6, OVT19 (K104, K103)

26. WILDFLOWER RESERVE-Beaver; Aliquippa & Clinton; NE of Raccoon Creek State Park; 300 Ac; Western Pennsylvania Conservancy; complete protection.
OVT4 SAF52, SAF62, SAF61, SAF39, SAF24, G1, A12, OVT19, OVT6 OVT8 (K104)

BUTLER COUNTY

27. ALLISON WOODS-Butler; Prospect; just N of Moraine State Park; 100 Ac; private; no protection.
OVT9 OVT5, OVT4, SAF25, SAF44, SAF52, SAF60 (K104, K102)

28. BEAR CREEK VALLEY-Butler; Foxburg; between Bruin and Parker; 500 Ac; State Game Lands; no protection.
SAF24 A12, G30, G17, G10, OVT5, OVT7, SAF52 (K104)

29. BURNS WOODS-Butler; Parker & Hilliards; 1 mile SW of Bruin; 10 Ac; private; no protection.
SAF52

— BUFFALO CREEK VALLEY-Armstrong & Butler; Freeport & Worthington; private; no protection. (see Nat. area #18)
A12 SAF52, SAF23, SAF24, Z13, OVT7, OVT4, G10 (K104, K106)

30. DESHON WOODS-Butler; Butler; 3 miles NW of Lyndora; 16 Ac; Butler Township; partial protection.
SAF52 (K104)

31. EPWORTH WOODS-Butler; Mars; 4 miles W of Mars; 30 Ac; private; no protection.
SAF52 (K104)

32. HEINER FOREST-Butler; Parker; just N of Bruin; 18 Ac; Western Pennsylvania Conservancy; complete protection.
OVT4 SAF52

33. HOGG WOODS-Butler; Slippery Rock; 2 miles NE of Slippery Rock; 30 Ac; private; no protection
SAF60 SAF53, G1, G11 (K104, K102)

34. JACKSON TOWNSHIP PARK-Butler; Zelienople; just N of Zelienople; 150 Ac; private; no protection.
OVT4 OVT9

35. JENNINGS NATURE RESERVE-Butler; Slippery Rock; 5 miles S of Slippery Rock; 300 Ac; Western Pennsylvania Conservancy; complete protection
OVT9 SAF16, SAF52, A29, A13, OVT6, OVT15, OVT19, OVT8, Z15 (K104)

36. LOWERY RUN-Butler; Emlenton; 1 mile SE of Emlenton; 90 Ac; private; no protection.
SAF23 A12, G10, OVT4 (K106)

37. McCORMICK GORGE-Butler; Slippery Rock; E of Moores Corners; 400 Ac; private; no protection.
G10 A12, G11, G1, SAF23, OVT4, A15, A23, SAF25, SAF59 (K103, K106)

38. MERIDIAN LABORATORIES-Butler; Butler; just NE of Meridian; 100 Ac; private; complete protection.
OVT8 Z16, SAF52, OVT6 (K104)

39. MILLER WOODS-Butler, Slippery Rock; 2 miles NW of Slippery Rock; 42 Ac; Slippery Rock State College; partial protection.
SAF27 SAF61, A23, G1, G11, A12 (K102)

40. MORAINE STATE PARK-Butler; Prospect and Chestnut and Slippery Rock; 15,921 Ac; State Park; partial protection.
G11 Z16, A19, A34, SAF16, SAF53, SAF52, SAF60, G1, OVT6, OVT19, (K104, K103)

41. ONEIDA DAM-Butler; East Butler; 4 miles NE of Butler; 200 Ac; water authority; partial protection.
Z16 OVT5

42. PARKER FOSSIL SITE-Butler, Parker; 1 mile SW of Parker; private; no protection.
G30 G17

43. RENFREW WOODS-Butler; Butler; W of Renfrew; 200 Ac; private; no protection.
OVT4 SAF59, SAF62, SAF52 (K103, K104)

44. ROUTE 488 OVERLOOK-Butler; Prospect; 2.2 miles N of the intersection of Rt. 488 and Rt. 422; 5 Ac; private; no protection.
G11

45. SCHOLAR'S RUN-Butler; Zelienople; 4 miles N of Zelienople; 80 Ac; private; no protection.
OVT9

46. SQUAW VALLEY RUN-Butler; Emlenton; SW of Emlenton; private; no protection.
SAF60 (K102)

47. TODD SANCTUARY-Butler, Freeport; 3.5 miles N of Freeport; 130 Ac; Audubon Society of Western Pennsylvania; complete protection.
SAF24 Z16, OVT7, OVT8, SAF52, SAF16, A12, G1, G10, OVT4 (K106, K104)

48. WEST LIBERTY ESKER-Butler; Slippery Rock; between West Liberty and Jackville; private; no protection.
G11

49. WOLF CREEK NARROWS-Butler; Slippery Rock; 2 miles NW of Slippery Rock; 100 Ac; private; no protection.
G10 SAF28, SAF59, SAF58, SAF60, G1, G11, A12, A29 (K106, K103)

CAMBRIA COUNTY

50. DUNLO FLATS-Cambria; Beaverdale; 2 miles SE of Dunlo; 200 Ac; private; no protection.
SAF19 SAF23, SAF16, G1, A25, A29 (K106)

51. ELMHURST BOG-Cambria; Ebensburg; 2 miles NE of Ebensburg; 10 Ac; private, no protection.
A25

52. LAUREL RIDGE STATE PARK-Cambria & Westmoreland & Somerset & Fayette; Johnstown & Rachelwood & Boswell & Ligonier & Bakersville, and Seven Springs & Kingwood & Mill Run & Ohiopyle; 15,436 Ac, State Park, 3,752 Ac. of which are in Cambria County; partial protection.
G6 OVT7, G10, A12, SAF44, SAF52, OVT19, OVT12 (K104)

53. PRINCE GALLITZIN STATE PARK-Cambria; Coalport; 6,600 Ac; State Park; partial protection.
SAF52 SAF25, SAF16, G1, A29 (K104, K106)

CLARION COUNTY

54. COOKS FOREST STATE PARK-Clarion & Jefferson & Forest; Cooksburg & Lucinda & Tylersburg & Marienville West; 7,822 Ac; partial protection. (Complete protection to 3 virgin tracts)
SAF21 SAF16, SAF22, SAF23, SAF24, SAF25, SAF52, G1, A12, A29 (K104, K106)

55. RIMERSBURG FOSSIL SITE-Clarion; Rimbersburg; 1.2 miles N of Rimbersburg; private; no protection.
G30 G17

CLEARFIELD COUNTY

56. BILGER ROCKS-Clearfield; Curwensville; 3.5 miles WNW of Curwensville; 30 Ac; private; no protection.
G10 G17, OVT7, SAF24, OVT12, OVT13 (K106)

57. CLEARFIELD FOSSIL REEF-Clearfield; Glenn Richey; 2 miles S of Clearfield; private; no protection.
G31 G17, OVT8, G1

58. NEW LONDON FOSSIL SITE-Clearfield; Ramey; 6 miles N of Beccaria; private; no protection.
G31 G17

59. QUEHANNA WILD AREA-Clearfield & Elk & Cameron; Driftwood & Sinnemahoning & Devils Elbow & Pottersdale; 50,000 Ac; Elk & Moshannon State Forests; partial protection.
SAF25 SAF16, SAF19, SAF44, SAF52, A29, G1, OVT6 (K104, K106)

ELK COUNTY

60. BIG HILL CREEK BOG-Elk; James City; Jones Township along Big Mill Creek S of a pipeline; 1 Ac; Allegheny National Forest; no protection.
A25 OVT9

61. BLACK CHERRY STAND-Elk; James City; 100 Ac; Kane Experimental Forest-Allegheny National Forest; partial protection.
SAF29 (K106)

62. BROCKPORT FOSSIL SITE-Elk; Brandy Camp; just N of Brockport; private; no protection.
G30 G17

63. DENTS FARM NATURAL AREA-(Proposed) Elk; West Creek; 2 miles N of Dents Run; 12+ Ac; Elk State Forest; complete protection.
SAF21 G1 (K104)

64. HIGHLAND BOG-Elk; James City; 1 mile N of Highland; 1 Ac; private; no protection.
A25

65. PAIGE RUN NATURAL AREA-(Proposed) Elk; Dents Run & Driftwood; 10 miles SW of Sinnamahoning; 917 Ac; Moshannon State Forest; complete protection.
SAF18 SAF16, SAF19, SAF52, G1, A29, OVT6 (K104)

— QUEHANNA WILD AREA-See Natural Area #59.

66. SPRING CREEK FOSSIL TRACKS-Elk; Hallton; NW of Hallton; 2 Ac; private; no protection.
G30 G17

FAYETTE COUNTY

67. ASKON HOLLOW-Fayette; Brownfield; SE of Fairchance; 300 Ac; private; no protection.
G9 OVT7, G10, G6, G17

68. BEAR RUN NATURE PRESERVE-Fayette; Mill Run; 2 miles S of Mill Run; 2,000 Ac; Western Pennsylvania Conservancy; complete protection.
OVT8 A12, G10, SAF52, SAF23, Z16 (K104)

69. CASPARIS CAVE-Fayette; South Connellsville; SE of Connellsville; private; no protection.
G9 G10, G6, G17

70. CONFLUENCE BOG-Fayette; Confluence; 3 miles W of Confluence; 10 Ac; private; no protection.
A25 G1

71. DEER LAKE MARSH-Fayette; Fort Necessity; 1.7 miles E of Chalkhill; 100 Ac; private; no protection.
A29 Z17

72. FALLINGWATER-Fayette; Mill Run; 3 miles N of Ohiopyle; 500 Ac; Western Pennsylvania Conservancy; complete protection.
SAF52 A12, G10, G6, G17, OVT7 (K104)

73. FOSSIL QUARRY: FAYETTE COUNTY-Fayette; Brownfield; 8 miles E of Uniontown; private; no protection.
G30 G17, G6

74. IGNEOUS INTRUSION-Fayette; Carmichaels; E of Adah on Middle Run; 3 Ac; State Game Lands #238; no protection.
G16 G13

75. INDIAN CREEK GORGE-Fayette; Mill Run; 4 miles NE of Mill Run; 700 Ac; private; no protection.
OVT7 A12, G10

— LAUREL RIDGE STATE PARK-See Natural Area #52 for descrip.; 2,841 Ac. of the 15,436 Ac. total are in Fayette County.

76. LICK RUN (LICK HOLLOW)-Fayette; Brownsfield; 7 miles E of Uniontown; State Forest; 1,000+ Ac; no protection.
SAF52 SAF59, G10, G6, A12, OVT7 (K104)

77. LINN RUN STATE PARK-Fayette; Ligonier; 560 Ac; State Park; partial protection.
SAF52 SAF25, SAF44, G1, G6, A12 (K104, K106)

78. MARKLEYSBURG BOG-Fayette; Ohiopyle; 6.1 miles E of Farmington; 10 Ac; private; no protection.
A25 OVT10, G1, SAF52

79. OHIOPYLE STATE PARK-Fayette & Somerset; Fort Necessity & Ohiopyle & Mill Run & South Connellsville; 18,483 Ac; State Park; partial protection (complete protection for the Ferncliff area).
SAF52 SAF59, G1, G10, G6, A12, OVT4, OVT6, OVT7, OVT19, OVT12, OVT13 (K103, K104)

80. QUEBEC WILD AREA (proposed)-Fayette; Smithfield & Brownfield; SE of Uniontown; 5,200 Ac; State Forest; partial protection.
SAF59 SAF52, SAF25, G10, G17, G9, A12 (K103, K104)

81. WHITE ROCKS-Fayette; Brownfield; 3.2 miles E of Fairchance; 100 Ac; private; no protection.
G10 G6, G17

FOREST COUNTY*

82. BEAVER MEADOWS-Forest; Lynch; 1,000 Ac; Allegheny National Forest; no protection.
A29 G1

--- COOKS STATE FOREST-See Natural Area #54.

83. HICKORY CREEK WILDERNESS-(Proposed) Forest; Cobham; NE of Queen; 12,800 Ac; Allegheny National Forest; no protection.
SAF25 OVT7, A29, Z17, G1, G10, A12, SAF23, SAF24 (K106)

84. TIONESTA FOSSIL SITE-Forest; Tionesta; W of Tionesta; private; no protection.
G30 G17

GREENE COUNTY

85. CARMICHAELS FOSSIL SITE-Greene; Carmichaels; 4 miles N of Carmichaels; private; no protection.
G31 G17

86. ENLOW FORK OF WHEELING CREEK-Washington & Greene; Wind Ridge & Claysville; 4 miles S of Claysville; private; no protection.
OVT4 OVT9, SAF26, SAF61, SAF52, SAF53, OVT19, OVT6, SAF59 (K104, K103)

87. RYERSON STATION STATE PARK-Greene; Wind Ridge & New Freeport; 800 Ac; partial protection.
G28 G1, SAF52, SAF59 (K103, K104)

INDIANA COUNTY

88. CLARK RUN NATURAL AREA-(Proposed) Indiana; Vintondale; N side of Conemaugh River; 3 miles W of Johnstown; 384 Ac; Forbes State Forest; complete protection.
SAF59 G6, G10, OVT12, OVT8, A12 (K103)

89. PINK LADIES SLIPPER WOODS-Indiana; Burnside; 3 miles N of Glenn Campbell; 3 Ac; private; no protection.
OVT5 SAF21

90. SUN CLIFF-Indiana; Brush Valley; 12 miles SE of Indiana; private; no protection.
SAF24

91. WURTZITE LOCALITY-Indiana; Elderton; just W of Shelocta; PennDot; partial protection.
G23 G17, G30, OVT10

JEFFERSON COUNTY

92. CLEAR CREEK STATE PARK-Jefferson; Sigel; 1,123 Ac; partial protection.
SAF52 SAF51, G1, A12 (K104)

--- COOKS FOREST STATE PARK-See Natural Area #54.

93. SUGAR HILL SCHOOL FOSSIL SITE-Jefferson; Carman; 3 miles W of Brockway; private; no protection.
G30 G17

LAWRENCE COUNTY

94. BLUE IRIS AREA-Lawrence; Harlansburg; 1.9 miles N of Harlansburg; 10 Ac; private; no protection.
OVT9 A29

95. BUCHANAN RUN-Lawrence; Edinburg; N of Pulaski; 110 Ac; Western Pennsylvania Conservancy; complete protection.
SAF24 G10, A12, OVT7, G11, SAF62, SAF52 (K106)

96. FRINGED GENTIAN BOG-Lawrence; New Castle S; 3 miles E of New Castle; 1 Ac; Western Pennsylvania Conservancy; complete protection.
A25 G11, OVT9

97. GARDNER SWAMP-Lawrence; New Castle South; 2 miles SE of New Castle; 15 Ac; private; no protection.
A29

98. KENNEDY MILLS-Lawrence; Portersville & Harlansburg; N of McConnells Mill State Park; 500 Ac; private; no protection.
G10 G11, A12, SAF23, SAF24, SAF25, G1, OVT7, (K103, K106)

99. LOCKE WOODS-Lawrence; Harlansburg; 2 miles NW of Harlansburg; 30 Ac; private; no protection.
SAF52 SAF53, A29, G1, G11, OVT19 (K104)

100. McCONNELLS MILL STATE PARK-Lawrence; Portersville; 2,000 Ac; complete protection (gorge portion).
G10 A12, SAF23, SAF24, SAF25, SAF44, SAF52, SAF59, G11, OVT7, OVT13, OVT4, OVT5, OVT12, OVT8, OVT9 (K103, K104, K106)

101. MUDDY CREEK FALLS-Lawrence; Portersville; N of Rose Point; 20 Ac; private; no protection.
G10 G11, OVT7, G1, A12

102. NORTH LIBERTY-BRENT SWAMP-Lawrence; Harlansburg; between N. Liberty & Brent; 100 Ac; State Game Lands 151; no protection.

103. PLAINGROVE BOG-Lawrence; Harlansburg; Just W of Plaingrove; 20 Ac; private; no protection.
A25 A29, G11

104. PLAINGROVE POTHOLE-Lawrence; Harlansburg; N of Plaingrove; 300 Ac; private; no protection.
G11 OVT9

105. QUAKERTOWN FALLS-Lawrence; Campbell; 1.2 miles E of the Ohio-Pennsylvania Line; 70 Ac; private; no protection.
OVT7 SAF54, SAF58, SAF50, G10, G17, A12, OVT13 (K103)

106. ROCK POINT-Lawrence; Beaver Falls; W of Ellwood City; 100 Ac; private; no protection.
OVT9 G10, OVT7, A12, G11, SAF59 (K103)

107. WAMPUM FOSSIL SITE-Lawrence; New Castle S; 0.7 miles S of Wampum; private; no protection.
G30 G17

MERCER COUNTY

108. BLACKTOWN SWAMP-Mercer; Mercer; 1.9 miles WNW of Grove City; 135 Ac; private; no protection.
A29

109. CRANBERRY SWAMP-Mercer; Hadley; S of Sunol; 150 Ac; private; no protection.
A29 G11, G1

110. FRENCH CREEK HEMLOCKS-Venango & Mercer; Utica; N of Utica; 200 Ac; private; no protection.
SAF24 SAF23, SAF25, SAF52, G11 (K104, K106)

111. FOWLER BOG-Mercer; New Lebanon; N of Carlton; 10 Ac; private; no protection.
A25 A29, G11, G1, OVT9

112. GREAT BLUE HERON ROOKERY-Mercer; Mercer & Grove City; 5.6 miles NW of Slippery Rock; 25 Ac; private; no protection.
Z16 A29

113. GROVE CITY FOSSIL SITE-Mercer; Grove City; 2.5 miles N of Grove City; private; no protection.
G30 G17

114. HALFMOON SWAMP-Mercer; Jackson Center; 4 miles N of Fairview; 50 Ac; private; no protection.
A29

115. MAURICE K. GODDARD STATE PARK-Mercer; Sandy Lake & Lebanon; NW of Hadley; 6,972 Ac; partial protection.
OVT8 (K104, K106)

116. McCLURE TRACT-Mercer; Hadley; 1 mile NE of Clark's Mill; 100 Ac; private; no protection.
SAF29 SAF28, G11 (K102)

117. MERCER BOG-Mercer; Greenfield; 2 miles SW of Mercer; 30 Ac; private; no protection.
A25 A22, A29, G1, G11, OVT9 (K94)

118. OTTER CREEK SWAMP-Mercer; Jackson Center; 5 miles W of Jackson Center; private; no protection.
A29 G11

119. PINE SWAMP-Mercer; Sandy Lake; 5 miles S of Sandy Lake; 200 Ac; Western Pennsylvania Conservancy; complete protection.
A29 SAF25, SAF39, SAF52, SAF53, G1, G11, A25, OVT9, OVT19 (K104, K106)

120. SCHOLLARDS RUN-Mercer; Mercer & Harlansburg; 1 mile E of Leesburg; State Game Lands; 1,000 Ac; partial protection.
A29

121. SHENANGO RESERVOIR-Mercer; Sharpsville & Freedonia; N of Sharon; 13,000 Ac; Corps of Engineers; no protection.
Z16 A29, A34, G1

122. SPRINGFIELD FALLS-Mercer; Mercer; 2 miles NE of Leesburg; 50 Ac; State Game Lands; partial protection.
SAF25 G1, G11, G10, A12, OVT7 (K106)

123. SWAMP ROOT-Mercer; Grove City; just SE of Swamproot; 100 Ac; private; no protection.
A29 G11

SOMERSET COUNTY

124. BEECHDALE HOLLOW-Somerset; Murdock & Meyersdale; 5 miles N of Meyersdale; 120 Ac; private; no protection.
SAF22 SAF24, SAF59, G1, A12 (K103, K104)

125. BIG SPRING-Somerset; Markleton; 5.7 miles NE of Listonburg; 5 Ac; private; no protection.
A15

126. KINGS BRIDGE PARK-Somerset; Kingwood; 1.6 miles W of New Lexington; 300+ Ac; private; no protection.
A29 OVT19, A13

127. LAUREL HILL STATE PARK-Somerset; Seven Springs & Rockwood & Kingwood & Bakersville; 4,169 Ac; State Park; partial protection.
SAF24 SAF25, SAF52, SAF44, SAF59, G1, A12 (K104, K103, K106)

--- LAUREL RIDGE STATE PARK-See Natural Area #52 for description; 5,354 Ac. of the 15,436 Ac; total are in Somerset County.

128. MOUNT DAVIS NATURAL AREA-Somerset; Markleton; 8 miles W of Meyersdale; 585 Ac; Forbes State Forest; complete protection.
G6 G10, SAF41, SAF44, SAF45, SAF43, SAF52, OVT11, OVT7, OVT17 (K104)

129. MOUNT DAVIS QUARRY-Somerset; Markleton; 3/4 mile W of Mount Davis; private; no protection.

130. PACK SADDLE-Somerset; New Baltimore & Fairhope; 2.4 miles NW of Fairhope; 400 Ac; private; no protection.
OVT7 OVT3, SAF22, G10, G6, A12

131. ROARING RUN SWAMP-Somerset; Somerset; 2 miles NE of Jennerstown; 100 Ac; private; no protection.
A29 G1

132. ROCKWOOD RESERVOIR-Somerset; Rockwood; NW of Rockwood; 30 Ac; water company; no protection.
SAF23 (K104)

VENANGO COUNTY

133. ALLEGHENY RIVER STATE PARK-Venango; Kennerdale & Polk; 3,140 Ac; State Park; partial protection.
SAF25 SAF52, A12, G1, G10 (K104, K106)

--- FRENCH CREEK HEMLOCKS-See Natural Area #110.

134. HEMLOCK WOODS KENNERDALE-Venango; Kennerdale; junction of Scrubgrass and Bullion Creeks; private; no protection.
SAF23 G11 (K106)

135. OIL CREEK STATE PARK-Venango; Titusville South & Oil City & Pleasantville; 7,197 Ac; partial protection.
SAF52 SAF24, SAF25, A12, G1, G10 (K104, K106)

136. WESLEY FOSSIL SITE-Venango; Wesley; 1 mile N of Wesley; private; no protection.
G30 G17

137. WHANN RUN/LOCKARD RUN-Venango; Eau Claire; 2 miles N of Lisbon; 110 Ac; private; no protection.
A12 G17, G10, OVT7, SAF23, SAF25 (K106)

WASHINGTON COUNTY

--- ENLOW FORK OF WHEELING CREEK-See Natural Area #86.

138. HILLMAN STATE PARK-Washington; Burgettstown & Clinton; 3,654 Ac; partial protection.
OVT8

139. LABORATORY FOSSIL SITE-Washington; Washington East; 1.7 miles S of Washington; private; no protection.
G30 G17

WESTMORELAND COUNTY

140. BEAR CAVE-Westmoreland; Boliver & Wilpen; NE of Derry; private; no protection.
G9 G10, Z17, G17, G6

141. BEAR CREEK-Westmoreland; Ligonier; 6 miles SE of Rector; 76 Ac; Rolling Rock Farms; partial protection.
SAF24 SAF25, A12, G1, OVT11 (K106)

142. BEAVER RUN RESERVOIR-Westmoreland; Slickville; 3 miles W of Slickville; 400 Ac; water company; partial protection.
Z16

143. BIG OAK WOODS-Westmoreland; Ligonier; 2 miles E of Rector; 300 Ac; Rolling Rock Farms; partial protection.
SAF59 (K103)

144. BUFFALO NUT SANCTUARY-Westmoreland; Stahlstown; 3 miles W of Stahlstown; 53 Ac; Carnegie Museum of Natural History; complete protection.
OVT9 SAF52, SAF59, G1, G6, A12 (K103, K104)

145. CON CAVE-Westmoreland; Boliver; NE of Derry; private; no protection.
G9 G10, G6, G17, Z17

146. CONEMAUGH GORGE-Westmoreland; Boliver; NE of Derry; 3,000 Ac; State Game Commission; partial protection.
G10 G6, G17, SAF52, OVT19 (K104)

147. COON CAVE-Westmoreland; Boliver; NE of Derry; private; no protection.
G9 G10, G6, G17, Z17, Z9

148. COPPERHEAD CAVE-Westmoreland; Boliver; NE of Derry; private; no protection.
G9 G10, G6, G17, Z17, Z9

149. DELMONT FOSSIL SITE-Westmoreland; Slickville, just S of Delmont; PennDot; partial protection.
G30 G17

150. DUFF PARK-Westmoreland; Murrysville; just S of Murreysville; 148 Ac; Franklin Township; partial protection.
SAF52 OVT4, OVT8, SAF27, SAF61 (K104)

151. FURNACE WOODS NATURE RESERVE-Westmoreland; Ligonier; 1 mile N of Laughlintown; 133 Ac; Carnegie Museum of Natural History; complete protection.
SAF59 SAF52, G1, A12, A29, OVT4, OVT8, OVT11 (K103, K104)

152. GUFFY HOLLOW-Westmoreland; McKeesport; 4 miles SE of McKeesport; 100 Ac; private; no protection.
OVT4 G10, OVT9, SAF59 (K103)

153. HIGH ROCKS VALLEY-Westmoreland; Derry; NE of Derry; 200+ Ac; private; no protection.
OVT7 G17

--- LAUREL RIDGE STATE PARK-See Natural Area #52; 3,488 Ac.of the 15,436 Ac. total are in Westmoreland County.

154. LEMON HILL-Westmoreland; Wilpen; 3.6 miles SW of New Florence; 70 Ac; Girl Scouts of Western Pennsylvania; partial protection.
SAF59 SAF52, OVT4, OVT8 (K103, K104)

155. LEMON HOLE CAVE-Westmoreland; Boliver; NE of Derry; Torrance State Hospital; no protection.
G9 G10, G6, G17, Z17, Z9, G30

156. LINN RUN BOG-Westmoreland; Ligonier; 7 miles SE of Rector; 30 Ac; Forbes State Forest; partial protection.
A25 Z16

157. MOUNTAIN STREAMS-ROARING RUN VALLEY-Westmoreland; Seven Springs; E of Champion; 3,000 Ac; Western Pennsylvania Conservancy; complete protection.
OVT7 SAF27, SAF25, SAF52, G6, G10 (K104)

158. POWDERMILL NATURE RESERVE-Westmoreland; Ligonier; 3 miles S of Rector; 1,800 Ac; Carnegie Museum of Natural History; complete protection.
OVT8 SAF44, SAF52, SAF59, SAF27, G1, G6, A12, Z16, OVT19, OVT 6 (K103, K104)

159. SILVERMINE RUN-Westmoreland; Ligonier; 2 miles E of Rector; 300 Ac; Rolling Rock Farms; partial protection.
SAF60 A12, SAF24, G10 (K103, K102)

--- TURTLE CREEK-See Natural Area #15.

BEGIN FIRST LINE OF TEXT HERE
TYPING GUIDE SHEET
CENTER OF PAGE
TOP OF IMAGE AREA
DROPPED HEAD; BEGIN SECTIONS HERE

APPENDIX C

HABITAT PREFERENCES OF THE FISHES OF WESTERN PENNSYLVANIA

6-1/2"
9-1/8"
BEGIN LAST LINE OF TEXT
BOTTOM OF IMAGE AREA OUTSIDE DIMENSION FOR TABLES AND ILLUSTRATIONS
3/8"
PAGE NUMBER
EPA-287 (Cin.)
(4-76)

APPENDIX C

HABITAT PREFERENCES OF THE FISHES OF WESTERN PENNSYLVANIA

Species Common Name	Low Gradient to Ponded, Turbid	Low Gradient Clear	Moderate Gradient Clear	High Gradient Clear and Cold	Comments
Goldfish	X	X	X		
Goldenshiner		X			
River Chub		X	X		
Silver Chub		X	X		
Northern Bigeye Chub		X	X		
Western Blackmore Dace			X	X	
Longnose Dace			X	X	
Northern Creek Chub	X	X	X	X	
Eastern Tonguetied Chub		X	X		Local Distribution Upper Allegheny River
Southern Redbelly Dace				X	
Redside Dace					
Common Emerald Shiner	X	X			
Silver Shiner		X	X		
Rosyface Shiner			X	X	
Central Common Shiner			X	X	
Northern Common Shiner				X	
Spotfin Shiner	X	X			Tolerates turbidity and pollution.
Northeastern Sand Shiner			X	X	Tolerates mine waste.

Species Common Name	Low Gradient to Ponded, Turbid	Low Gradient Clear	Moderate Gradient Clear	High Gradient Clear and Cold	Comments
Northern Mimic Shiner		X	X		
Silverjaw Minnow			X	X	Tolerates mine waste.
Northern Flathead Minnow	X	X			
Bluntnose Minnow	X	X	X	X	
Ohio Stoneroller Minnow			X	X	
Channel Catfish	X	X			
Yellow Bullhead		X	X		
Brown Bullhead		X	X		
Black Bullhead	X	X			
Flathead Catfish		X	X		
Stonecat Madtom		X	X		
Brindled Madtom	X	X			
Eastern Banded Killifish					
Troutperch		X			
Brook Silverside		X			May be extinct because of turbidity and pollution.
White Coppil	X	X	X		
Black Crappie	X	X	X		
Northern Rockbass			X		Requires clean water with rock or gravel bottom. Much of former habitat destroyed.

Species Common Name	Low Gradient to Ponded, Turbid	Low Gradient Clear	Moderate Gradient Clear	High Gradient Clear and Cold	Comments
Northern Smallmouth Blackbass		X	X		Originally abundant, much habitat destroyed by siltation.
Northern Largemouth Blackbass					
Green Sunfish	X	X			
Northern Bluegrass Sunfish		X	X		
Central Longear Sunfish		X			Intolerant to high turbidity.
Pumpkinseed Sunfish		X	X		
Yellow Walleye		X			Intolerant to turbidity and silt bottoms.
Yellow Perch	X	X	X		
Blackside Darter		X	X		Sensitive to pollution.
Longhead Darter			X	X	Original habitat destroyed by mine drainage.
Gilt Darter		X	X		
Ohio Logperch Darter		X	X		Intolerant to pollution.
Greenside Darter		X	X		
Eastern Banded Darter		X	X	X	

Species Common Name	Low Gradient to Ponded, Turbid	Low Gradient Clear	Moderate Gradient Clear	High Gradient Clear and Cold	Comments
Ohio Lamprey		X			
Allegheny Brook Lamprey				X	
Ohio Brook Lamprey				X	
Longnose Gar		X			
Eastern Gizzardshad	X	X			
Brown Trout			X	X	Cold Water less than 65° F.
Rainbow Trout			X	X	
Brook Trout				X	Coldest headwater tribs.
Central Mudminnow			X		
Central Redfin Pickerel		X			
Ohio Muskellunge			X		
Central Quillback Carpsucker	X	X			
Silver Redhorse		X			
Golden Redhorse			X		
Ohio Redhorse			X		
Hog Sucker			X	X	
Common White Sucker	X	X	X		
Carp	X	X	X		

Species Common Name	Low Gradient to Ponded, Turbid	Low Gradient Clear	Moderate Gradient Clear	High Gradient Clear and Cold	Comments
Variegated Darter		X	X		
Spotted Darter		X			
Bluebreast Darter		X	X		
Rainbow Darter		X	X	X	Intolerant to pollution.
Barred Fantail Darter		X	X		
Freshwater Drum	X	X			Rare or absent because of commercial fishing.
Central Redfin Sculpin				X	
Brook Stickleback		X			
Bigmouth Buffalo	X				
Black Redhorse			X		
River Redhorse		X			

SOURCE: Green International, Inc. (34,35).